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HAWAIIAN  
ENTOMOLOGICAL  
SOCIETY

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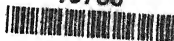
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*Each volume consists of three annual parts*

HONOLULU, HAWAII



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PROCEEDINGS  
OF THE  
Hawaiian Entomological Society

Editor Emeritus, O. H. Swezey

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VOL. XII, No. 1

FOR THE YEAR 1943

AUGUST, 1944

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This issue of the Proceedings is the first ever to appear without Mr. O. H. Swezey as its editor. After nearly forty years, at his own request, Mr. Swezey has relinquished the direction of this periodical in order to devote himself more fully to his studies of the native Hawaiian insect fauna. Under his editorship the Proceedings attained a position unique among journals of its kind, and constitutes an enduring monument to Mr. Swezey's long devotion to Hawaiian entomology. The amount of work he devoted to the production of the Proceedings cannot be fully appreciated by most of us. We know, however, that he has given to it the same fresh interest and zest which all phases of entomology claim from him. For the Society we wish to express our appreciation of his long and efficient service as editor, and the hope that as Editor Emeritus, he will continue for many years to counsel his successors on the editorial committee.

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JANUARY 11, 1943

The 445th meeting was held at the H.S.P.A. Experiment Station on Monday, January 11, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Faxon, Fullaway, Holdaway, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Stains, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Lt. R. L. Douth, U.S.N.

NOTES AND EXHIBITIONS

*Records from Kauai*—Mr. Krauss presented the following data on material collected on Kauai: *Stenotrupis marshalli* Zimmerman; one specimen of this small weevil was taken at Lihue on October 18, 1942. Hitherto it has been recorded only from the island of Oahu and from Samoa. The specimen was identified by Mr. Zimmerman. *Latrodectus geometricus* Koch; found fairly abundant in



a rocky bank near the pier at Port Allen on October 16, 1942; identified by Prof. R. V. Chamberlin of the University of Utah. *Tetranychus* sp., identified by Mr. E. A. McGregor of the U.S. Bureau of Entomology and Plant Quarantine; collected on taro (*Colocasia esculenta* Schott) at Kapaia on October 20, 1942, and on cotton at Nawiliwili on the same date.

*Cyrtopeltis varians* (Distant)—Mr. Krauss reported finding nymphs and adults of the tomato bug abundantly on several plants of the wild spider flower (*Gynandropis pentaphylla* De Candolle) in Honolulu on December 24, 1942.

*Thysanoptera from Maui*—Mr. Krauss reported the collection on Maui of the following thrips, all identified by Mr. Sakimura: *Taeniothrips frici* Uzel, on the flowers of the common dandelion (*Taraxacum officinale* Weber) at an elevation of 9,000 feet on Haleakala, April 14, 1940. The Hawaiian thrips, *Thrips hawaiiensis* (Morgan), the composite thrips, *Microcephalothrips abdominalis* (Crawford), and *Haplothrips gowdeyi* (Franklin), were found on flowers of the golden crown-beard, *Verbesina encelioides* (Cav.) Benth. & Hook., at Makena on the same date.

*Acrodrepanis megalophylla* (Meyr.)—A male specimen of this rare moth was exhibited by Mr. Swezey. He had found it among other unidentified material which he was recently examining. The specimen had a pencilled label as from Kilauea, Hawaii, collected by Dr. R. C. L. Perkins, without date, but it must have been collected sometime before 1904. There has been no specimen of this moth hitherto in the H.S.P.A. collection.

*Hydriris exaucta* (Meyr.)—Mr. Swezey exhibited a specimen of this rare pyralid moth similarly found among unidentified material as above. Its pencilled label was Kukuihaele, Hawaii, but without date or collector's name. It was most probably collected by Dr. Perkins at an early date. The species was described in the Proceedings of the Society (7 (1):95, 1928) from specimens collected at Kaholuamano and Kokee, Kauai, 1920 (Kusche), and Halehaku, Maui (Bryan). The present record would extend its range to the island of Hawaii. Presumably this is an endemic species. It was not previously represented in the H.S.P.A. collection.

Parasitism of *Plusia* by *Litomastix*—Mr. Swezey reported on some recent records of parasitism by the polyembryonic encyrtid, *Litomastix floridana* (Ashmead), on *Plusia chalcites* (Esper) caterpillars collected in the field at various localities on Oahu. *Plusia* caterpillars had been scarce for quite a time, but had become more prevalent during a recent rainy spell, and parasitism has been quite pronounced.

Dec. 12. Experiment Station, H.S.P.A., seven caterpillars on *Emilia* were 43 per cent parasitized.

- Dec. 20. 2044 Lanihuli Drive, Manoa, ten caterpillars on sweet-potato leaves were 80 per cent parasitized.
- Dec. 21. Ewa Plantation, 19 caterpillars collected on the weed, *Verbesina*, by F. X. Williams, were 10 per cent parasitized.
- Dec. 31. Ewa Plantation, 22 caterpillars on an unidentified weed (Williams), were 9 per cent parasitized.
- Jan. 7. Waialua Agricultural Company, Mill Field no. 9, 15 caterpillars collected on lima beans (Van Zwaluwenburg) were 80 per cent parasitized.

*Eucelatoria armigera* (Coq.)—Mr. Swezey reported rearing this tachinid fly from *Plusia chalcites* caterpillars collected by Dr. Williams on weeds at Ewa Plantation, Dec. 21 and 31. Of 19 caterpillars collected on Dec. 21, 31 per cent were parasitized by this tachinid. Of 22 collected Dec. 31, 41 per cent were parasitized. These are the first rearings of this fly from field material in Hawaii.

*Mongoose capturing a monarch butterfly*—Dr. Williams stated that on January 10, at his house in upper Kēeaumoku Street, two nearly grown mongooses were seen at the edge of tall grass. Presently a monarch butterfly, *Danaus plexippus* (Linn.), fluttered low nearby. One of the mongooses became somewhat interested and followed the insect for a while, but when the butterfly, hovering at a low weed, drew the attention of the second mongoose, the latter rushed at it and caught it in its jaws, seizing, in the act, a bit of plant leaf at which the butterfly had been pausing. The mongoose made away with its prize in the tall grass.

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## FEBRUARY 8, 1943

The 446th meeting was held at the H.S.P.A. Experiment Station on Monday, February 8, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Fullaway, Holdaway, Illingworth, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Thomas Farr, U.S.N.

## PAPERS

Mr. Swezey presented, and discussed briefly, two papers entitled: "Synonymy of *Euxoa hephaestaea* (Meyrick)", and "The Kou Moth, *Ethmia colonella* Walsm., in Hawaii".

## NOTES AND EXHIBITIONS

*Apanteles marginiventris* (Cresson)—Mr. Pemberton spoke of the establishment of this armyworm parasite on the grounds of the H.S.P.A. Experiment Station, from specimens reared by Dr. Wil-

liams from material sent in last year from Brownsville, Texas by F. A. Bianchi. Some of these wasps, including a number that had already been used in oviposition on caterpillars, had been liberated on the Station grounds, with the result that their cocoons were found on nutgrass in January, and wasps hatched from them.

*Eucelatoria armigera* (Coq.)—Mr. Van Zwaluwenburg told of rearing this tachinid fly on nutgrass armyworm larvae, *Laphygma exempta* (Walker) in the laboratory. The ready acceptance by *Eucelatoria* of *Laphygma* caterpillars gives promise of value in controlling this pest in the field. The female fly deposits nearly mature maggots within the host, by means of a thorn-like larvipositor, and the life cycle is extremely short. In this connection Mr. Swezey described his discovery of the way in which our larger tachinid, *Chaetogaedia monticola* (Bigot), parasitizes noctuid caterpillars. The fly oviposits on vegetation which by chance may be eaten by a caterpillar, which ingests the *Chaetogaedia* egg without harm to the latter, but eventually with dire results to itself.

*Records from Palmyra Island*—Mr. Krauss reported the following interceptions made on March 20, 1942 at the Honolulu Plant Inspection Office in a shipment of bird's-nest ferns (*Asplenium* sp.) from Palmyra Island: one earthworm; four sowbugs (*Philoscia* sp.; det. J. O. Maloney, U.S. National Museum); and one immature spider (*Heteropoda* sp.; det. R. V. Chamberlin, University of Utah).

*Graptostethus nigriceps* Stål—Mr. Krauss reported finding two specimens of this bug on January 18, 1943 in a package of wood-rose pods (*Ipomoea tuberosa* Linn.) being mailed to the mainland. On January 19 two more were collected on the foliage and pods of this plant at 3066 Wailani Road, Pacific Heights, Honolulu, where the mail shipment had originated.

*Aphis gossypii* Glover—Mr. Krauss reported collecting the cotton or melon aphid at the following places on Kauai: on sweet potato at Lawai-kai, October 19, 1942; on taro (*Colocasia esculenta* Schott) at Kapaia, October 20; on cotton at Waimea, October 23; and on cucumber at Hanapepe, October 28. The specimens were identified by Dr. P. W. Mason, U.S. Bureau of Entomology and Plant Quarantine.

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### MARCH 8, 1943

The 447th meeting was held at the H.S.P.A. Experiment Station on Monday, March 8, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Holdaway, Krauss, Look, Marlowe, McPhail, Nishida, Pemberton, Rosa, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Messrs. T. C. Russell and Y. Tanada.

## PAPER

Mr. Look presented a paper by himself and Mrs. Ethel Lucas McAfee entitled: "Some First Records of Aphids in Hawaii".

## NOTES AND EXHIBITIONS

*Grasshoppers feeding on Irish potato*—Dr. Holdaway and Mr. Look exhibited plants of Irish potato showing the injury by three species of grasshopper, *Conocephalus saltator* (Sauss.), a long-horned grasshopper, and *Atractomorpha ambigua* Bolivar and *Oxya chinensis* (Thunb.), short-horned grasshoppers. The attack by *Conocephalus* consisted of large holes in the leaves, and was concentrated on the younger leaves of the plant. Attack by *Atractomorpha* consisted of holes of irregular shape, but in general not as large as those made by *Conocephalus*. Attack by *Atractomorpha* was concentrated on the older leaves. Attack by *Oxya* consisted of removal of the distal end of several leaflets and complete removal of two mature leaves, completely severed from the plant; the leaf petioles were cut through near the main stem.

The injury done by each species was the result of accumulated feeding over a period of four days, all species having been introduced at 1:00 p.m., March 4. *Atractomorpha* had begun feeding immediately it was introduced into the cage with the potato plant. *Conocephalus* had not fed for three hours after introduction, but was feeding the following morning, 19 hours after introduction. *Oxya* did not feed on the potato plant during the first two days. The injury described was found on the fourth day but may have been made any time between the second and fourth day.

This is not the first time injury by these grasshoppers has been secured under controlled conditions. On one previous occasion *Oxya* had severed the main stem, causing injury comparable to that made by a large cutworm on Irish potato.

In the annual report for 1940 of the Hawaii Agricultural Experiment Station (p. 39) reference was made to the fact that *C. saltator* and *O. chinensis* had attacked the foliage of Irish potato. The correctness of these observations was questioned by some local entomologists. It was pointed out, as indicated by Dr. Williams in his "Insects and Other Invertebrates of Hawaiian Sugar Cane Fields", that *Oxya* fed on the leaves of sugar cane and grasses, while *Conocephalus* prefers an insect to a vegetable diet, and thrives upon leafhoppers and aphids. It was stated that the alimentary tract of *C. saltator* did not normally contain chlorophyll-bearing plant tissue. Williams, however, refers to the fact that it feeds to a slight extent on the margin of leaves of rice and on pineapple.

The observations here described, and the injury exhibited, indicate that all three species will feed on the foliage of Irish potato. Individuals of *C. saltator* are common in potato fields. Further

observations may indicate the conditions under which attack occurs.

*Phyllocoptes destructor* Keifer\*—Dr. Holdaway reported the occurrence of the tomato russet mite on tomato on the islands of Oahu and Maui. This eriophyid was first observed and collected on tomato plants in the garden of Dr. F. G. Krauss, Parker Place, Manoa Valley, Honolulu, May 26, 1942. Additional records are the following:

Waimanalo, Oahu, on tomato, Sept. 8, 1942, coll. F. G. Holdaway; Pensacola substation, H.A.E.S., Honolulu, on tomato, Nov. 7, 1942, coll., Wm. C. Look; Omaopio, Maui, on tomato, Nov. 23, 1942, coll. F. Murphy. The plants on which this mite was collected at Manoa Valley were young plants which were so severely attacked they would have succumbed if control measures had not been adopted promptly. The plants infested at Waimanalo were severely attacked and production was prevented. Some of the plants in this field were also attacked by broad mite, *Hemitarsonemus latus* Banks. At Waimanalo the weed, *Solanum nodiflorum* Dunal (*S. nigrum* Linn.), was also infested by *P. destructor*. Mr. Murphy, who collected the specimens on Maui, reported that the mite was causing severe damage and about 90 per cent loss of the crop. All the specimens collected on Oahu have been identified by H. H. Keifer.

The occurrence of *P. destructor* in Hawaii has already been referred to by Dr. Schmidt (Proc. Haw. Ent. Soc., 11 (3): 275, 1943). The specimens on which Dr. Schmidt's record is based were collected Sept. 22, 1942, at a place only a few blocks from where the specimens collected last May were taken. Two of the records given above, however, antedate Dr. Schmidt's record. It would appear that this mite has become established in Hawaii comparatively recently. Its establishment on the island of Maui follows rapidly on its introduction to Oahu.

*Erinose mite of litchi*—Dr. Holdaway and Mr. Nishida reported that specimens of the erinose mite of litchi (*Litchi chinensis* Sonn.), hitherto apparently unidentified, had been submitted to Dr. Keifer for determination. He has replied that it is *Eriophyes chinensis* Trotter,† but that the species has never been adequately described. With the material forwarded to him he is now proceeding to draw up figures of the species.

Leaves of litchi exhibiting the characteristic felting were examined during the period between August 31 and November 10, 1942 without their yielding evidence of the presence of mites. On November 10, leaves from trees which had been examined during the previous months were found heavily infested with the mites.

\* Described in "Eriophyid Studies X", Bull. Cal. Dept. Agr., 29: 161-162, fig., 1940.

† Dr. Keifer has since described the litchi mite of Hawaii as *Eriophyes litchii* ("Eriophyid Studies XIII", Bull. Cal. Dept. Agr., 32(3): 212, pl. 171, July-September, 1943). (Ed.)

Evidence of the presence of mites in numbers has continued to be secured up to February. The lack of evidence of mites during the late summer months and their appearance in numbers in November, when the fall rains began, suggested a periodicity of broods possibly associated with the rains and the flush of new growth.

*Lepta trilineata californica* Schaeffer—Mr. Krauss presented the following note on the three-lined potato beetle. Adults, larvae and egg masses were found abundantly on the solanaceous weed, apple of Peru (*Nicandra physaloides* Gaertner), in Kaimuki, Honolulu on February 26, 1943. This is a new host record. The following are unpublished early records of this species: the first specimens found in the Islands were collected on poha (*Physalis peruviana* Linn.), in the back yard of a house on Johnson Lane (off Liliha Street, above Vineyard), Honolulu, on September 15, 1933 by Miss F. Segawa, a university student. These were the specimens recorded without details in the Proceedings of the Society (8 (3): 389, 1934). Masao Nakano, another university student, collected about ten specimens at night in a house on Enos Lane in the Makiki district of Honolulu, some time between October 20 and 29, 1933. On March 6, 1934 Mr. Krauss found adults, larvae and egg masses on leaves of the angel's trumpet, *Brugmansia arborea* (Linn.), in the grounds of the Territorial Office Building, Honolulu, and on March 29 adults, larvae and egg masses were found on leaves of the jimson weed (*Datura stramonium* Linn.) on the University of Hawaii campus. This beetle is now established on the islands of Oahu, Kauai, Maui, Molokai and Hawaii. Besides the hosts noted above, it has been found breeding on *Datura metel* Linn., *D. tatula* Linn., cup of gold (*Solandra guttata* Don), Irish potato, and *Physalis mollis* Nuttall. Mr. Pemberton remarked that he had found this beetle on tobacco at the H.S.P.A. Experiment Station in Makiki.

*Elimaea punctifera* (Walker)—Mr. Krauss reported finding several nymphs of this narrow-winged katydid feeding on buds and flowers of azalea plants growing outdoors in pots in Manoa Valley, Honolulu, on March 1, 1943. The flowers were entirely ruined.

*Telmatoctonus albipunctatus* (Williston)—Mr. Russell spoke of the abundance, in annoying numbers, of this large psychodid moth-fly at the Naval hospital at Aiea, Oahu. The larvae were very numerous among rocks forming the filter for the sedimentation basin for the water supply.

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#### APRIL 12, 1943

The 448th meeting was held at the H.S.P.A. Experiment Station on Monday, April 12, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Faxon, Goolsby, Holdaway, Krauss, Look, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Yoshinori Tanada.

#### PAPER

Mr. Look and Mrs. Ethel Lucas McAfee presented a paper entitled: "New Host Records of Aphids in Hawaii."

#### NOTES AND EXHIBITIONS

*Nymphula oblitalis* (Walker)—Mr. Swezey reported rearing the water lily moth from larvae feeding on water lily leaves in the pond at Central Union Church on Beretania Street, a new locality for the occurrence of this moth.

*Hydra viridis* Linn.—Mr. Swezey reported finding this fresh water hydra on the under side of lily leaves in the lily pond in the Central Union Church grounds in March of this year, and again today. Six were found on one leaf. It is the second place he has seen *H. viridis* in Honolulu; the first was in Moanalua gardens in 1916 on a water lily leaf.

"*Insects of Guam—I*"—Mr. Swezey called to attention that in a mention of this publication in Experiment Station Record (88 (2): 218, Feb. 1943), the statement: "The list is said to contain about 50 species not known to occur in Hawaii", is misleading. In the reviewer's paragraph the statement is in reference to "*Insects of Guam—I*", which contains 361 species, whereas it actually should refer to a previously noted paper on "A Survey of the Insect Pests of Cultivated Plants in Guam", published in The Hawaiian Planters' Record (44 (3): 151-182, 1940), and reviewed in Experiment Station Record (84 (3): 358, March 1941).

*Tachinid parasites taken in wind traps*—Mr. Sakimura presented the following: Wind trap data from Kunia, Oahu, pineapple fields, showed that through the summer up until the end of October 1942, there was practically no flight of tachinid flies or of their hosts. Now, after very active flight during the five months from November 1942 to March 1943, they have practically disappeared. The tachinids caught during the five-months period were: 111 *Eucelatoria armigera* (Coq.) (two-thirds males); 14 *Frontina archippivora* (Williston) (one-half males); 13 *Chaetogaedia monticola* (Bigot) (one-quarter males); and 1 *Archytas cirphis* Curran. The moths caught were: 169 *Laphygma exempta* (Walker); 43 *Lycophotia margaritosa* (Haworth); 29 *Plusia chalcites* (Esper); and 3 *Cirphis unipuncta* (Haworth). After heavy rain during November, followed by the wet months of December and January, *L. exempta* appeared in outbreak numbers, with the peak of flight during December and January. A short active flight of

*P. chalcites* occurred during January, and of *L. margaritosa* during February. *Eucelatoria* suddenly appeared in a large group during January and February. An occasional flight of *Frontina* was observed during December, January and February, while flights of *Chaetogaedia* occurred throughout the five months. The number of species attacked by each parasite is difficult to determine from the present data. It is noteworthy that *Eucelatoria* was the predominating tachinid in the area during the period covered by these notes. Messrs. Swezey and Van Zwaluwenburg were consulted for the determination of the species.

*Synonymy of some Hawaiian Staphylinidae*—Mr. Van Zwaluwenburg called attention to some recent synonymy among immigrant species of Hawaiian staphylinids. In his "Monograph of the West Indian Beetles of the Family Staphylinidae" (U.S. National Museum Bull. 182, 658 pp., 1943) Dr. R. E. Blackwelder discusses five widely distributed species which are known from Hawaii as well as from the area under consideration. Only one of these, *Philonthus discoideus* (Gravenhorst), is retained under the name familiar to Hawaiian entomologists. The other four are either referred to other genera or synonymized as follows:

*Trogophlocus senilis* Sharp 1880 is a synonym of *Carpelimus fulvipex* (Erichson) 1840 (pp. 62-63).

*Oxytelus ferrugineus* Kraatz 1859 (*O. bledioides* Blackbn. & Sharp 1885) is referred (pp. 96-98) to *Oxytelus incisus* Motschulsky 1857.

*Ancaeus laevigatus* (Kraatz) 1859 (*Lispinodes pallescens* Blackbn. 1885) is synonymized (pp. 158-160) under *Paralispinus exiguus* (Erichson) 1840.

*Medon debilicornis* (Wollaston) 1857 is referred (pp. 267-269) to *Sunius debilicornis* (Wollaston).

*Triatoma rubrofasciata* (Degeer)—Mr. Pemberton reported a case of this bug biting a woman at Kaimuki, Honolulu, during March and April 1943, and causing severe pain and swelling on one side of the face and one arm, accompanied by pronounced reddish blotches on the skin. Numerous small reddish spots appeared on the face and arm where the bug had evidently fed. Illness persisted for three weeks. A search of the bed where the woman slept resulted in finding the bug, the abdomen of which was greatly distended with blood.

*Euscepes postfasciatus* (Fairmaire)—Mr. Pemberton reported finding this weevil extensively breeding in the fleshy roots of *Ipomoea triloba* Linn., near Aiea, Oahu, on March 18, 1943. This morning-glory vine has not previously been reported in Hawaii; it was identified by E. L. Caum.

*Haplogonatopus vitiensis* Perkins—Mr. Pemberton reported observing a number of small, white cocoons attached to the dried silk



on corn ears in a field at Kailua, Oahu, on Feb. 19, 1943. These were collected and from them, later, emerged adults of this dryinid. Previously known hosts of this parasite of delphacids have been the sugar cane leafhopper (*Perkinsiella saccharicida* Kirkaldy), the taro leafhopper (*Megamelus prosperina* Kirkaldy), both in Hawaii, and a delphacid on grass in Fiji, possibly different from *P. saccharicida*. Finding the cocoons on corn suggested that the parasite was breeding on the corn leafhopper (*Peregrinus maidis* [Ashmead]). Subsequently the adult dryinids which emerged from the cocoons readily parasitized corn leafhoppers confined with them, and normal adults were reared from this material.

*Anthonomus eugenii* Cano—Mr. Krauss reported finding fruits of the purple-fruited cherry pepper (*Capsicum frutescens cerasiforme* [Mill.]) heavily infested with pepper weevil larvae in the Kapalama district of Honolulu on March 23, 1943.

*Walnut insects*—Mr. Krauss reported that *Ephestia cautella* Walker, the almond moth, and *Oryzaephilus surinamensis* (Linn.), the saw-toothed grain weevil, were found abundantly in a package of unshelled walnuts which had been stored for some time by a resident of Honolulu. The nuts were entirely ruined.

*Laphygma exigua* (Hübner) on Johnston Island—Mr. Krauss reported that larvae of this species, the beet armyworm, were submitted for determination by a naval officer who reported them as doing severe damage, during the early part of April 1943, to ornamental shrubs and vines on Johnston Island, lying southwest of the Hawaiian group.

*Maruca testulalis* (Geyer) in *Gliricidia* flowers—Mr. Goolsby submitted the following: In February, when *Gliricidia sepium* (Jacq.) Steud. trees first began flowering, two or three short stems of blossoms were collected from trees growing near Pearl City, about a half-mile from the highway on the old Honolulu road. These were placed in a cage, and on March 1 adult moths began emerging. Ten *Maruca testulalis* adults emerged, and 11 larvae and pupae died in the cage. One *Lampides boeticus* (Linn.) (the bean lycaenid butterfly) and one *Amorbia emigratella* Busck also emerged from the lot. Early in March, four stems of flowers about six inches long were taken and caged. From these, 15 *Maruca* adults emerged, and one *Amorbia*. Again the mortality of larvae and pupae was about 50 per cent. Thus, in six or seven short stems of *G. sepium* flowers, about 50 *Maruca* were feeding. From one tree thousands of these insects would emerge during the flowering season, and it seems probable that such an increase might have a noticeable effect upon the infestation of crops such as string and lima beans.

*Graftostethus nigriceps* Stål—Dr. Williams spoke of finding a specimen of *G. nigriceps* on the outside of a laboratory window at

the H.S.P.A. Experiment Station, Honolulu, on March 31, 1943. This chiefly red and black lygaeid bug has but recently been taken here.

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### MAY 10, 1943

The 449th meeting was held at the H.S.P.A. Experiment Station on Monday, May 10, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Faxon, Holdaway, Krauss, Look, Marlowe, Nishida, Pemberton, Rosa, Sakimura, Stains, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Yoshinori Tanada.

Dr. Holdaway nominated Mr. Yoshinori Tanada for membership in the Society.

### NOTES AND EXHIBITIONS

*New insect records from Kauai*—Mr. Krauss presented the following list of insects taken on Kauai in October 1942, none of which apparently has been recorded before from that island:

#### *Orthoptera:*

*Tenodera angustipennis* Saussure. Chinese mantid; egg case collected Nawiliwili, October 20.

#### *Coleoptera:*

*Amphicercus cornutus* (Pallas); Waimea, October 23, in dead branches of kiawe, *Prosopis chilensis* (Molina) Stuntz.

*Bruchus limbatus* Horn; Waimea, October 23.

*Calandra linearis* (Herbst); tamarind weevil, Waimea, October 23.

*Carpophilus hemipterus* (Linn.); dried-fruit beetle, Nawiliwili, October 21.

*Oryzaephilus surinamensis* (Linn.); saw-toothed grain beetle, Lihue, October 15.

*Pantomorus godmani* (Crotch); Fuller's rose beetle, Waimea, October 23.

*Platynus lividigaster* Mulsant; yellow-shouldered lady-beetle, Anahola, October 26.

*Scymnus notescens* Blackburn; Hanapepe, October 28.

*Tribolium ferrugineum* (Fabr.); rusty flour beetle, Nawiliwili, October 21.

*Calandra granaria* (Linn.)—Mr. Krauss exhibited two specimens of the granary weevil collected in a Honolulu grain and feed warehouse April 29, 1943, together with a number of rice weevils, *Calandra oryzae* (Linn.). The granary weevil is apparently very seldom found in the Hawaiian Islands.

*Eucelatoria armigera* (Coq.)—Mr. Van Zwaluwenburg presented the following: Laboratory breeding of this recently established tachinid fly, on *Laphygma exempta* (Walker) larvae, showed no correlation between the sex ratio of the adult flies and the number of maggots per individual host. From 54 *Laphygma* larvae the following data were obtained:

	Per cent males
13 larvae produced 1 puparium each: 8 males and 5 females issued	61
16 larvae produced 2 puparia each: 17 males and 11 females issued	60
9 larvae produced 3 puparia each: 13 males and 13 females issued	50
2 larvae produced 4 puparia each: 5 males and 3 females issued	62
10 larvae produced 5 puparia each: 16 males and 23 females issued	41
1 larva produced 6 puparia each: 4 males and 1 female issued	80
1 larva produced 7 puparia each: 6 males and 0 females issued	100
2 larvae produced 8 puparia each: 6 males and 8 females issued	42
TOTAL: 76 males and 64 females issued	53.9

A total of 176 *Eucelatoria* from *Laphygma*, including those tabulated above, as well as some for which the number of puparia per host was not recorded, showed a total of 86 males and 90 females, or 48.8 per cent males. An illustrated account of *Eucelatoria* appears in The Hawaiian Planters' Record, 47 (2): 81-87, 1943.

*Hemitarsonemus latus* Banks—Dr. Holdaway and Messrs. Look and Nishida exhibited several economic plants showing symptoms of injury by the broad mite: papaya, beet, chard, pepper and green bean.

*Phyllocoptes destructor* Keifer—The following new records of occurrence on Oahu, of the tomato russet mite were contributed: University of Hawaii campus, by Mr. Nishida; McKinley School garden, by Dr. Holdaway; and Kalihi, by Mr. Look.

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## JUNE 14, 1943

The 450th meeting was held at the H.S.P.A. Experiment Station on Monday, June 14, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Fullaway, Goolsby, Holdaway, Hyslop, Krauss, Look, Marlowe, McBride, Nishida, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Franklin Sherman III, Capt., Sanitary Corps.

Mr. Yoshinori Tanada was elected to membership in the Society.

By unanimous vote the Treasurer was instructed to send, on behalf of the Society, the sum of \$25 to the Zoological Society of London as a contribution to the financing of the Zoological Record.

## NOTES AND EXHIBITIONS

*Xyletobius aleuritis* Perkins—Mr. Swezey exhibited a specimen of this rare anobiid beetle which he had cut out of a dead spot in a kukui (*Aleurites moluccana* Willd.) trunk in Ukumehame Valley, Maui, August 29, 1929. It had been collected previously only on Oahu, first by Dr. Perkins in April 1892: two examples dug out of dead kukui wood at a low elevation in the Waianae Mts. The next collection on Oahu was by O. H. Swezey in Makaleha Valley, Feb. 1, 1931: eight beetles from a standing dead kukui tree very much honeycombed by the larvae. Then again by Swezey in Kamo-kunui Valley, Oct. 1, 1933: two beetles under bark of *Pipturus*. The specimens of these last two collections were determined by Dr. Perkins (Proc. Haw. Ent. Soc., 9 (1):87, 1935). Dr. Perkins states that: "The species is very different from any other and is not really congeneric with any Hawaiian anobiid". It is much larger than any other species of *Xyletobius* except one, *durranti* Perkins.

*Lycophotia margaritosa* (Haworth)—Mr. Swezey exhibited a variegated cutworm moth which was reared from a caterpillar found feeding in green tomatoes. Four of the caterpillars were found by Mr. Wm. Weinrich in tomatoes growing in a specially constructed screen house on Kewalo Street, May 15, 1943. One moth matured June 11. The other caterpillars were pickled. At first it seemed quite a mystery how these caterpillars could gain access to the screened house. The only feasible explanation seemed to be that an egg cluster had been deposited on a leaf of overhanging branch of avocado tree, as it is known that this moth has the oviposition habit of placing its eggs on leaves which may not necessarily be the normal food of the caterpillars. In this instance some of the young caterpillars, on hatching, may have dropped by spun thread to the screen roof of the house and gained access, where they at first had fed on the tomato leaves, and later attacked the green fruit. Apparently there is no previous record in Hawaii of caterpillars of this moth attacking green tomatoes.

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JULY 12, 1943

The 451st meeting was held at the H.S.P.A. Experiment Station on Monday, July 12, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Carter, Faxon, Fullaway, Holdaway, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmermann.

*Visitor:* Thomas W. Cook.

## NOTES AND EXHIBITIONS

*Cryptorhynchus mangiferae* (Fabr.)—Mr. Swezey reported some observations on the present prevalence of the mango weevil. He had examined the seeds from mangoes which were eaten at different times as they fell from a heavily loaded mango tree on Lanihuli Drive, Manoa Valley, June 13 to July 9, 1943. Altogether 379 seeds were examined, and 90 per cent of them contained weevils in one stage or another: small larvae, 6 per cent; full grown larvae, 28 per cent; pupae, 40 per cent; mature beetles, 25 per cent. Some of the seeds contained more than one weevil: 26 per cent contained two weevils, and 4 per cent contained three weevils. As these mangoes were larger than usual for this particular tree, and were better flavored than usual, it would appear that having this high infestation of the seeds by the mango weevil was not detrimental to the fruit, nor had it caused premature dropping of the fruit. There has been some expression of opinion that the weevils caused premature dropping of fruit and undersized fruit. This is not borne out by the present observation. As a check in regard to this, fallen immature fruits from an adjacent tree were examined and the seeds of 83 per cent of them contained no weevils, though they were found in 67 per cent of the seeds of the fully matured fruit that fell from the same tree.

*Graptostethus nigriceps* Stål—Mr. Swezey reported having collected an adult of this new immigrant lygaeid bug on hibiscus in his garden, 2044 Lanihuli Drive, Manoa Valley, June 26, 1943. Mr. Look exhibited another adult taken on eggplant at the Puuhue Victory garden (Kalihi district), Honolulu on May 15; no nymphs were present. Both these records are additional stations in the spread of this insect.

*Hercothrips fasciatus* (Pergande)—Mr. Sakimura reported that the long-feared establishment of the California bean thrips in these Islands, must now be recorded. *H. fasciatus* was found among a series of thrips recently collected by Mr. Krauss on Molokai. He collected, on June 4, 1943, a large number of specimens from leaves, flowers and buds of prickly poppy (*Argemone glauca* Linn.) growing along the roadside near Kaunakakai. The present limits of this insect's distribution are not yet known. Identification of the material was verified by Mr. Dudley Moulton.

*Frankliniella* sp.—Mr. Sakimura reported that this species, common on Oahu, was recently collected by Mr. Krauss on Molokai and Maui.

*Psocids on stored dog food*—Mr. Krauss reported that many specimens of *Deipnopsocus* sp. and a few of *Liposcelis divinatorius* (Mull.) were collected on a commercial dry dog food made of cereal, meat, fish meal, etc., in Honolulu on January 18, 1943. The dog food had been stored for some time. Determinations were

made by Mr. H. K. Townes through the U.S. Bureau of Entomology and Plant Quarantine.

*Orthezia insignis* Douglas—Mr. Pemberton reported receiving a branch of pamakani (*Eupatorium glandulosum* H.B.K.) collected in Honalua gulch, Maui, at 2,000 feet elevation by F. W. Broadbent, which was heavily infested with this coccid. Though this insect has been known in Hawaii since 1899, this is apparently the first record of its occurrence on pamakani in the Islands. Mr. H. T. Osborn in 1924 recorded noticeable injury to pamakani by an *Orthezia* at Cuernavaca, Mexico.

Biological control of *Pseudococcus brevipes* (Ckll.)—Dr. Carter presented the following: The abandonment of ratoon pineapple fields due to labor shortages has resulted in many areas where mealybug populations on the developing ratoon fruit have reached a considerable size. At the same time the fields have become very weedy. Under these circumstances, biological control of *P. brevipes* has been sufficient to almost completely eliminate the insect from the fruit. The principal factor operating is undoubtedly *Lobodiplosis pseudococci* Felt, the predaceous midge collected in Mexico by Mr. Fullaway. Many fruits can be found plastered with the old webs of this insect, with no mealybugs left alive on the fruits.

With such control evident, it is interesting to speculate on why biological control of the mealybug is not more generally successful. First among the possible reasons is the establishment of large populations on fruit. The midge is rarely found on leaves, possibly because the mealybugs on leaves keep moving down into the dark center of the plant, as the leaves grow. On the other hand, mealybugs on the bases of fruits are more sessile and give opportunity for the midge to establish its web over the developing female mealybug. Second is the fact that in a weedy field, *Pheidole* ants are apparently more independent of mealybugs for food, and their attendance on the mealybug is not as close as normally.

Unfortunately, even in these fields where the mealybugs on fruit are practically wiped out, residues of the populations are to be found on all the developing suckers in the vicinity of the infested fruits. These colonies are untouched by the midge, and it is these colonies which will cause mealybug wilt in the developing suckers. It is clear that no biological factor can operate to prevent mealybug wilt unless it is capable of reducing populations of mealybugs on young, unfruited plants, well attended by ants.

Egg parasite of *Pycnoderes*—Mr. Fullaway recorded the establishment here of a new species of *Anagrus*,\* a parasite of the egg of *Pycnoderes quadrimaculatus* (Guerin), recently imported from Sinaloa, Mexico.

\* *Anagrus yatei* Fullaway; see p. 57.

*Bufo marinus* (Linn.)—Dr. Williams spoke of the homing faculty of the giant toad, *Bufo marinus*. This summer adult males were marked by cutting off the tips of certain toes, and brought from a small lily pond on upper Keeaumoku Street to the H.S.P.A. Experiment Station on the same street, a distance of about 2300 feet. One *Bufo*, blind in one eye, that had previously returned, was back the second time in 29 days. Of four other normal males, a large specimen carried in a sack to the Experiment Station was back to the lily pond within six days, the other three not having appeared to date. At present, and for some time, there has been a great preponderance of males in this lily pond.

### AUGUST 9, 1943

The 452nd meeting was held at the H.S.P.A. Experiment Station on Monday, August 9, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Bianchi, Fullaway, Holdaway, Krauss, Look, Marlowe, McBride, Nishida, Pemberton, Rosa, Sakimura, Schmidt, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Ensign H. E. Graham, U.S.N.

### PAPER

Mr. Swezey presented a paper entitled: "Keys to Some Lepidopterous Larvae Found in Gardens and Homes in Hawaii."

### NOTES AND EXHIBITIONS

*Uloborus geniculatus* (Olivier)—Mr. Swezey exhibited this interesting spider, the name of which he found in "The Spider Book" by Comstock (Gertsch revision; p. 267, 1940). It is a tropical species of both hemispheres. It has made its appearance somewhat recently in Hawaii. It was especially abundant in his basement, with numerous webs in all possible positions. The earliest dated specimen in the H.S.P.A. collection is 1927.

*Trichogramma minutum* Riley—Mr. Swezey exhibited a slide mount of this parasite reared from an egg of *Heliothis armigera* (Hübner) on a tomato leaf, Honolulu, July 29, 1943. This is perhaps the first record of rearing this parasite from *Heliothis* in Hawaii.

*Lasioderma serricorne* (Fabr.)—Mr. Swezey reported having counted 1227 of the cigarette beetle in a small container of dried herbs, which had been entirely consumed, leaving a layer of fine black frass at the bottom. All stages were found: adults, pupae and larvae, and there were eggs amongst the frass. The eggs were not counted.

*Telenomus rhopali* Perkins—Mr. Swezey exhibited a slide mount of this scelionid, eight of which had issued from a cluster of 19 eggs of *Corizus hyalinus* (Fabr.) on a flower bud of *Sonchus oleraceus* Linn. collected by the roadside on Manoa hill above Punahou School grounds in June 1943. This is a parasitism of 42 per cent.

*Pleistodontes imperialis* Saunders—Mr. Pemberton reported the rearing of quantities of this caprifying fig wasp (family Agaonidae) from fruits of *Ficus eugenioides* F. v. Mueller, collected in upper Manoa Valley, Honolulu on August 4 by E. L. Caum. This is of interest since the insect is the normal caprifier, or pollinator, of *Ficus rubiginosa* Desfontaines, and was introduced into Hawaii in 1921 to induce the production of viable seed of this tree. The close similarity of *F. eugenioides* and *rubiginosa* suggests that one is merely a variety of the other, in view of the present breeding record.

*Murgantia histrionica* (Hahn)—Mr. McBride spoke of the presence, in all stages, of the harlequin cabbage bug in Victory gardens in Kalihi, Honolulu, on broccoli.

*New host of Mediterranean fruit fly*—Mr. McBride recorded the balsam apple (*Momordica balsamina* Linn.) as a new host for *Ceratitis capitata* (Wiedemann).

*An aphid new to Hawaii*—Mr. Zimmerman reported collecting *Aphis ferruginea-striata* Essig on carrot at Wilhelmina Rise, Honolulu, August 13, 1942. The material was identified by Prof. E. O. Essig. This California species, which occurs on celery also, has not been recorded heretofore from the Hawaiian Islands. It was described in *Hilgardia* (9 (9): 464, fig. 3, 1938).

*Parasites of tomato pin worm*—Mr. Fullaway exhibited two new Braconidae reared from *Keiferia lycopersicella* (Busck), the tomato pin worm. One is a species of *Apanteles*, the other, an undetermined genus, new to the Territory. They were secured in June 1943 by Messrs. Swezey, Fullaway and others.\*

*Two aphids new to the Hawaiian Islands*—Mr. Krauss presented the following notes on two aphid species not previously known from Hawaii, both determined by Prof. E. O. Essig: *Aphis tavarcsi* Del Guercio, collected at Wailuku, Maui, June 6, 1943; this species occurs on *Citrus* in Japan, Australia and South Africa. Specimens of *Neophyllaphis araucariae* Takahashi were taken on leaves of Norfolk Island pine (*Araucaria excelsa* R. Brown) near the edge of Waikolu Valley, Molokai, June 3, 1943, and on the same host plant at Hana, Maui, June 30. This is the same aphid collected by Timberlake on *Araucaria* in Kapiolani Park, Honolulu, January 30, 1916 (Proc. Haw. Ent. Soc., 3(4): 267, 1917). The species was described by Takahashi (Proc. Roy. Ent. Soc. London

\* See p. 22.



(B) 6: 105, fig., 1937) from specimens collected in Mauritius on *Araucaria cunninghamii* Aiton.

*Graptostethus nigriceps* Stål—Mr. Nishida reported taking this lygaeid bug on eggplant at the Kaimuki Victory garden, July 23, 1943. This species was first taken by Mr. Sakimura in the Kūnia district, Oahu, July 21, 1942.

Mr. Zimmerman reviewed the publication by J. T. Patterson et al. entitled: "Studies in the Genetics of *Drosophila* III. The *Drosophilidae* of the Southwest." (The University of Texas Publication 4313, 327 pp., ill., 1943). The following *Drosophilidae* which occur in Hawaii are illustrated in full color in this excellent volume: *Chymomyza procnebris* (Williston), *Drosophila ananassae* Doleschall, *D. mercatorum* Patterson & Wheeler, *D. melanogaster* Meigen and *D. hydei* Sturtevant.

### SEPTEMBER 13, 1943

The 453rd meeting was held at the H.S.P.A. Experiment Station on Monday, September 13, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Fullaway, Goolsby, Holdaway, Krauss, Look, Marlowe, Pemberton, Sakimura, Schmidt, Swezey, Tanada, Usinger, Williams and Zimmerman.

*Visitor:* T. C. Russell.

### PAPERS

Mr. Zimmerman, on behalf of Dr. R. A. Cushman, presented a paper entitled: "The Hawaiian Species of *Enicospilus* and *Abanchoastra* (Hymenoptera: Ichneumonidae)". Mr. Zimmerman also presented his own paper: "A Case of Bovine Auricular Myiasis and Some Ectoparasites New to Hawaii".

### NOTES AND EXHIBITIONS

*Argiope avara* Thorell—Mr. Swezey reported seeing a female of this spider on a web with two egg cocoons hanging to the electric wire near his place on Lanihuli Drive, Manoa. The spider has been scarce of late years on account of the ichneumonid, *Tromatobia rufipectus* (Cresson), feeding on its eggs.

*Cremastobombycia lantanella* Busck—Mr. Swezey reported having examined 110 mines of this moth in lantana leaves, August 23, 1943, in which 95 per cent of the larvae had been destroyed by parasites. Only three moth larvae were found, and two cocoons. A moth issued from one cocoon, and the eulophid parasite, (*Pseudopheliminus vagans* Timberlake), from the other, September 1.

*Ampulex compressa* (Fabr.)—Mr. Swezey reported some interesting observations on the New Caledonia cockroach wasp, made in the basement of his house. In one instance a female wasp was observed to enter a crack to an incompletely closed drawer to the workbench, and very quickly emerged again; then in a few moments returned with small bits of shavings in her mandibles. She was watched as she repeated this procedure half a dozen times in ten minutes. Then, on opening the drawer, an Australian cockroach was found behind an object in a corner of the drawer, where the wasp had attempted to enclose it by bits of shavings. An egg was found on the roach, which was then placed in a vial for the development of the parasite. The adult wasp issued in about six weeks. In another instance, an Australian cockroach was found in a small pasteboard carton among a pile of cartons. The roach seemed sluggish, and on examination was found to harbor a wasp larva on the ventral side of the thorax. The carton contained a mass of shredded paper used in packing. There was enough of a gap at one corner of the cover so that a wasp could enter, and it is inferred that she had found the roach already inside, and paralyzed it and oviposited on it right there, rather than dragged it in for seclusion.

*Truck garden pests*—Mr. Fullaway exhibited specimens of the onion leaf miner, *Acrolepia assectella* (Zeller), a plutellid moth new to the Territory. It was found in all the valleys back of Honolulu, as well as at Kailua, Oahu. Mr. Fullaway reported mites bad on Irish potatoes and yams, while the Mexican mealybug (*Phenacoccus gossypii* Towns. & Ckll.) was in heavy concentration on such crops as lima beans and eggplant.

*Acrolepia assectella* (Zeller)—Dr. Holdaway exhibited two cocoons of this onion moth collected by Walter Furuya in April 1939 on onion. Although the place record appears on the specimens as University campus, the material was probably collected at Kalihi, where Mr. Furuya had an experimental plat in which onions were being grown. This insect, identified by Mr. Swezey, has recently been the subject of study by Mr. Fullaway who found it on green bunching onions in Manoa Valley and other places in, or near, Honolulu. The specimens had been awaiting identification for some time and had remained unidentified until additional material was collected recently. The insect is recorded as a pest of onion and leek in Europe (Denmark, Germany and Russia). To date it appears not to be widespread in Hawaii, for Dr. Holdaway, who has just returned from a visit to Maui and Hawaii, stated that he had seen no evidence of it in the onion fields and plats he examined on those islands. However, except for the possible exception of one or two fields in Manoa, it does not seem to be serious yet.

*Tiphia segregata* Crawford—Mr. Sakimura reported that in the Kunia section of Oahu this parasite has been observed flying in

fairly large numbers among the wild growth immediately outside pineapple fields. Parasitized *Anomala* grubs have been found in pineapple fields, although a very small number of pupal shells were found there. The first case of parasitized *Anomala* was recently found (August 1943) among a lot of grubs dug from a Waipio pineapple field. Of 382 grubs, 25 (6.3 per cent) were parasitized. There was no parasitism by *Campsomeris marginella modesta* Smith among this material. These data show that *Tiphia* may operate in large numbers on *Anomala* grubs in pineapple fields under certain conditions.

*Graptostethus nigriceps* Stål—Mr. Sakimura said that general populations of this recently found lygaeid bug seem to have increased somewhat this season. During the summer of 1942 two individuals were caught in the wind traps at Kunia, while up to the present time this year more than 20 have been taken. Large numbers of the adults were observed feeding in the flowers of sweet potato and wild morning-glory in Kunia.

*Stictocephala festina* (Say)—Mr. Sakimura reported a very heavy infestation of this membracid on bush beans, which were badly damaged in a home garden under his observation. The insect showed a specific preference for this host; no other plants were attacked.

*Alphitobius diaperinus* (Panzer)—Mr. Zimmerman reported rearing this tenebrionid beetle from larvae found abundantly in the nests of English sparrows in Honolulu.

*New cockroach egg parasite from Honolulu*—Mr. Zimmerman presented the following: For a period of about two years I have had under observation the pretty little chalcid wasp recorded as a new immigrant *Metaphycus* by Mr. Pemberton (Proc. Haw. Ent. Soc., 11 (2): 139, 1942). I have found this parasite common over most parts of Honolulu, and had assumed from its habits that it was probably a cockroach parasite, in spite of the scale-infesting habits of its well known relative, *Metaphycus lounsburyi* (Howard). It is now possible to report that this elegant newcomer is an effective parasite of the oöthecae of the commonest household cockroach in Honolulu, *Supella supellectilium* (Serville). I have reared as many as 20-odd parasites from a single oötheca, and, at least in one locality, have found the rate of parasitism to be almost, or 100 per cent of, all oöthecae found. It is not known whether or not the parasite is host specific, but studies on the wasp are continuing, and further details as to its identity and habits will be forthcoming.

*Solenopsis geminata rufa* Jerdon—Mr. Pemberton reported this ant as killing tomato plants at Waialua, Oahu, by eating holes in the stems, chiefly underground.

OCTOBER 11, 1943

The 454th meeting was held at the H.S.P.A. Experiment Station on Monday, October 11, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Bianchi, Faxon, Fullaway, Holdaway, Hyslop, Look, Marlowe, Nishida, Pemberton, Rosa, Sakimura, Swezey, Usinger, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* T. C. Russell and Capt. Franklin Sherman III.

## PAPER

Mr. Swezey presented a paper entitled: "Notes on *Zaischnopsis* sp., an Egg-parasite of *Holochlora japonica* in Hawaii".

## NOTES AND EXHIBITIONS

*Scholastes bimaculatus* Hendel—Mr. Swezey exhibited a large coconut which had been found to have hundreds of maggots of this ortalid fly in the husk, from the beach at Niu, Oahu, September 26, 1943. The nut had been caught in a barbed wire entanglement where, splashed by the waves, the husk had been softened and a good deal of its outer surface torn off. Maggots were somewhat yellowish in color when small, turning bluish when about full grown. They apparently fed on the moistened soft material between the fibers of the husk. There was no evidence of rotting. Maggots formed puparia in situ, though the nut was placed over sand in a jar, presuming that the maggots would issue and pupate in the sand.

Later note by Mr. Swezey: Later on, many maggots did issue from the husk and formed puparia in the sand beneath the coconut. Adult *Scholastes* began to issue on October 8 and records were kept daily. The bulk of them issued between October 20 and November 20, but there were a few scattering issues up to December 11. The total count was 1380, of which 42 per cent were females and 58 per cent males. They were constant in wing pattern, there being no variation that could approach a single unidentified specimen in the H.S.P.A. collection, collected in 1905, which differs from other specimens by having two distinct dark bars across the wings. It seems evident that this must be another species.

*Prohippelates pallidus* (Loew)—Mr. Swezey reported that this chloropid fly issued from the above coconut even more abundantly at first than *Scholastes* did.

*Synonymy of two Hawaiian moths*—Mr. Swezey called to attention that Corbett and Tams (*The Entomologist*, 76: 15, 1943) state that *Ephestia kuehniella* Zeller is a synonym of *Ephestia sericaria* (Scott), and that *Endrosis lactella* (Schiffermüller) is a synonym of *Endrosis sarcitrella* (Linn.).

*Hawaiiiana wilsoni* (Rothschild)—Mr. Swezey called attention to the recent discovery in the literature, of a new genus, *Hawaiiiana*, erected by Tutt (The Ent. Record and Journ. of Variation, 15:76, 1903). The genus was made for the Hawaiian Sphingidae which were described under *Deilephila* and later placed by Rothschild and Jordan in *Celerio*. Two species were known at the time: *wilsoni* and *calida* (Butler); a third species, *Celerio perkinsi* Swezey, was described later.

*Acrolepia assectella* (Zeller)—Mr. Swezey reported that he had received word from Dr. Muesebeck that Mr. Heinrich had confirmed the determination of the plutellid onion moth which was recently found attacking onion crops in Manoa Valley, as the above species. It is an onion pest in Europe, and also feeds on garlic, leeks and chives.

*Eumerus marginatus* Grimshaw and *E. aurifrons* (Wiedemann)—Mr. Swezey reported rearing these syrphid flies from maggots found in cassava root (*Manihot utilisima* Pohl) from Kailua, Oahu, July 21, 1943. Apparently the infestation had begun in a diseased portion of the root, and had worked on into the sound portion, causing it to rot. The first two flies to mature were *E. aurifrons*, appearing August 2 and 16. Most of the maggots were of the larger species, *E. marginatus*. They were full grown by September 10, and the flies matured before September 28. Fourteen issued and died before being noticed, as the tin they were in was not examined for several days.

*Parasites of tomato pin worm*—Mr. Fullaway reported that the parasites bred from *Keiferia lycopersicella* (Busck) had been identified by Dr. Muesebeck as *Hormius pallidipes* Ashmead\* and *Apanteles dignus* Muesebeck,\*\* both species being new records for Hawaii. Mr. Look reported that *Hormius* was first collected on October 10, 1942 at Waimanalo, Oahu, and later at Luahualei, Oahu on June 25, 1942. He stated that a third parasite reared from tomato pin worm has been identified by Dr. Muesebeck as *Chelonus blackburni* Cameron.

*Micromyzus formosanus* (Takahashi) on Maui—Mr. Fullaway reported finding the onion aphid at Olinda, Maui; this is a new island record for this species.

*Megachile gentilis* Cresson—Mr. Van Zwaluwenburg reported finding cells of this common megachilid bee under odd circumstances. Within an onion leaf which had been perforated by either a *Heliothis* or a *Lathyrga exigua* (Hübner) larva, four cells of the bee were found on August 17 at Waipio substation. The leaf material from which the cells were made was not identified. The first bee emerged September 23-24. This species is better known

\* Described from Maryland in Trans. Amer. Ent. Soc., 20:42, 1893.

\*\* Described from California in Proc. Ent. Soc. Washington, 40(7): 203, 1938.

locally as *Megachile palmarum* Perkins, a synonym. The identification was made by Dr. Williams.

*Corizus hyalinus* (Fabr.)—Mr. Van Zwaluwenburg presented the following notes on this coreid bug: Nymphs and adults were confined in large glass tubes and each day given fresh pieces of *Sonchus oleraceus* Linn., bearing blossoms or buds, on which they fed readily. When *Emilia sonchifolia* De Candolle or *Euphorbia* spp. were substituted, no feeding on these plants was observed. Egg-laying was confined mainly to the buds, but sometimes occurred on the petioles. The eggs, attached by a very short pedicel, were laid in clusters of from one to 18, with an average of 4.4 eggs per cluster. All eggs, without exception, hatched.

The egg stage required about 125 hours at an average mean temperature of 78.2 degrees Fahrenheit. The five instars from hatching to adult required a total of 15 to 16 days. Oviposition first took place between 72 and 78 hours after attaining the adult stage. One laboratory-bred female lived 35 days in captivity, and, ovipositing on each of 32 consecutive days, laid a total of 387 eggs (averaging 12 eggs per day of laying). A field-collected female lived 27 days in captivity (then escaped) and laid 350 eggs; she failed to produce even one egg on only three days of the entire period. A field-collected male survived for 41 days. Laboratory-bred females mated when three days old (at which time males first became available) and continued to mate daily until within a day of death.

Dr. P. A. Readio (Ann. Ent. Soc. America, 21: 187-201, 1928) working in Kansas with this species, reared it readily on *Lactuca scariola* Linn. Temperatures during this period were somewhat higher than those during observations in Honolulu, reaching the nineties and upper eighties at mid-day, whereas here they seldom exceeded 85 degrees Fahrenheit. Comparisons between Readio's results and those obtained here are interesting:

	Kansas	Honolulu
Preoviposition period .....	3-4 days	3 + days
Egg stage .....	6-7 "	5.2 "
Hatching to adult .....	9-11 "	15-16 "
Adult to adult .....	17*"	23-24 "

The maximum survival of laboratory-bred females recorded by Readio was 50 days, with a maximum of 558 eggs laid.

*Apanteles marginiventris* (Cresson)—Mr. Pemberton reported finding a cocoon of this armyworm parasite on a blade of grass at Wailua, Kauai on September 23, 1943. The cocoon later produced a normal female. This is the first evidence of the establishment of this braconid on the island of Kauai, where liberations were made during January and February 1943. The recovery was made at

\* Minimum.

least a mile from any point where liberations were made. The parasite was introduced into Hawaii from Brownsville, Texas, by F. A. Bianchi during 1942-43.

*Mosquitoes developing in brackish water*—Mr. Pemberton mentioned receiving about two gallons of water taken from wells in the coral plain at Ewa, Oahu, by Capt. Franklin Sherman III, which contained large numbers of larvae of *Culex quinquefasciatus* Say, as well as many of *Aedes albopictus* (Skuse). Analysis of this water by the chemistry department, Experiment Station, H.S.P.A., showed a salt concentration (mostly sodium chloride) of 2992 mg. per liter. All stages of larvae were present, together with pupae. Normal appearing adults began hatching within 24 hours.

*Mites and thrips on asparagus*—Severe injury, probably by the common red spider and *Thrips tabaci* Lindeman, was reported by Mr. Sakimura on a large commercial planting of asparagus at Waipahu. Many brown areas were scattered among the older plantings, and populations of both mites and thrips were extremely high there. Two predaceous thrips, *Aelothrips fasciatus* (Linn.) and *Scolothrips sexmaculatus* (Pergande), were vigorously preying upon them, and the former species especially, was unusually abundant. This is the first record of *A. fasciatus* on Oahu. The common *Frankliniella* sp. was also present on the plants, but was not noticeably abundant.

*Hercothrips fasciatus* (Pergande)—Mr. Sakimura reported that this notorious thrips was not found among Kauai material collected by Mr. Nishida during August. A special effort was made to detect this species at various localities, but it could not be found. This thrips was also absent from an extensive, systematic collection, still in progress, made on the leeward side of Oahu, especially at Waipahu, Manoa and Waialae. This species therefore does not seem to have become established as yet on Kauai or Oahu.

#### NOVEMBER 8, 1943

The 455th meeting was held at the H.S.P.A. Experiment Station on Monday, November 8, at 2:00 p.m., with Vice-president Fullaway in the chair.

*Members present:* Messrs. Bianchi, Fullaway, Krauss, Look, Nishida, Pemberton, Rosa, Sakimura, Schmidt, Swezey, Van Zwaluwenburg and Zimmerman.

*Visitors:* Ensigns Harry P. Chandler and H. E. Graham; T. C. Russell, and Capt. Franklin Sherman III.

The name of Mr. Kenneth Murakami was proposed for membership in the Society.

#### PAPERS

The following papers were presented: "Thrips from Maui and Molokai", by Messrs. Sakimura and Krauss; "Heteroptera of Can-

ton Island", by Dr. Usinger; and "Description of a New Mymarid Egg Parasite Collected at Los Mochis, Sinaloa, Mexico", by Mr. Fullaway.

#### NOTES AND EXHIBITIONS

*Apanteles marginiventris* (Cresson)—Mr. Pemberton reported on the spread of this armyworm parasite on the island of Kauai. On November 4 he found, without difficulty, cocoons of this parasite attached to grass at Kilauea Plantation Company, and reared the adult from one of the cocoons the following day. By direct line this is about 20 miles from any point on the island where liberations were made eight months previously. A cocoon of this parasite was also found on a grass blade at Olokele Sugar Company on November 5, which was approximately 25 miles from the nearest point of liberation. The spread of this braconid is of exceptional interest because of the great scarcity of its host during the entire period since the original liberations were made.

*Mosquitoes on inter-island planes*—Mr. Pemberton commented on the ineffectiveness of control methods adopted by the Hawaiian Airlines Ltd., in the prevention of mosquitoes moving from Oahu to other islands on their passenger airplanes. On three trips which he made during October and November, living mosquitoes were captured by him on planes while in flight, from 10 to 20 minutes after the planes had been sprayed with the widely-used "aerosol bomb". The spray is pyrethrum extract suspended in "freon" gas. It appeared that the failure to kill resulted from an insufficient liberation of gas or spray. Operators in each case allowed the gas to escape for only seven seconds at most. All living mosquitoes caught were *Culex quinquefasciatus* Say.

*Technomyrmex albipes* (F. Smith)—Mr. Pemberton discussed the prevalence of colonies of this ant in tightly curled leaves of the litchi tree (*Litchi chinensis* Sonn.) at Waiakea, Hawaii, which he found on October 20. In each case the occupied leaves were heavily infested with the litchi mite, *Eriophyes litchii* Keifer,\* and curled and deformed through this infestation. Entire colonies of the ant occurred in the leaves.

*Cardiocondyla emeryi* Forel—Mr. Swezey reported having a recent letter from Dr. M. R. Smith of the U.S. National Museum, in which he had determined as *emeryi* some specimens among other specimens of *Cardiocondyla* which had been sent him for study. In fact, there were more of this species in the lot than there were of the other species of *Cardiocondyla* known here. Apparently *emeryi* has been in Hawaii for some time; however, when Dr. Wheeler looked over ant collections here in 1930, he did not note any specimens of *emeryi*.

\* Described in "Eriophyid Studies XIII", Bull. Cal. Dept. Agr., 32(3): 212, pl. 171, July-Sept. 1943. This species was until now apparently misidentified under the name *Eriophyes chinensis* Trotter (Bull. Soc. ent. France, 1900: 180).



*Iridomyrmex humilis* Mayr—Mr. Fullaway said that the area now occupied by the Argentine ant measured about one-quarter by one-half mile, and was still confined to the military reservation on which it was first found here in 1940.

*Tachiothrips xanthius* (Williams)—Mr. Sakimura reported that this thrips was recently found to be breeding freely on leaves of *Asystasia gangetica* (Linn.) (family Acanthaceae) growing under benches of an orchid house in Manoa. Orchids, especially *Cypripedium*, in this house have been seriously injured. Contact sprays consisting of nicotine sulfate and "loro" have been used, but thrips persisted in spite of spraying. It is now evident that persistence was due to the presence within the orchid house of an alternative host plant. Keeping orchid houses free from *Asystasia* is evidently necessary for control of this thrips, which is one of the most injurious insect pests of orchids in Hawaii. Careful search on various weeds within the orchid house, and also on *Asystasia* growing immediately outside, did not reveal the presence of this thrips. It also failed to establish itself on several other species of plants under experimental conditions. Its extremely narrow host range indicates that dissemination from one orchid house to another occurs when orchid plants are transferred, but for survival within the house it probably depends on *Asystasia* in addition to orchids. This thrips has been known to be very injurious in the West Indies, eastern United States and Brazil, but no alternative host has been recorded, and it has been thought to be a specific feeder on orchids. It was once collected from insect galls on a plant other than orchids in Florida. This thrips has been known in Hawaii since 1935.

*Cryptoblabes aliena* Swezey—Mr. Krauss reported that larvae of this phycitid moth were found feeding on berries of the Christmas berry tree, *Schinus terebinthifolius* Raddi, in Manoa Valley, Honolulu, during September. The insect was causing an unsightly webbing in the clusters of ornamental berries.

*Latrodectus mactans* var. *hesperus* Chamberlin & Ivie—Mr. Krauss reported that specimens of this variety of the black widow spider were collected in south central Molokai on May 31, 1943. This variety is the one found in California and other western states. *Latrodectus geometricus* Koch was taken in the same area on the same date. The specimens were determined by Prof. R. V. Chamberlin.

*Thecla echlion* (Linn.)—Mr. Bianchi exhibited two small chili peppers which had been thoroughly destroyed in a Honolulu garden by caterpillars of this species, which were now in the pupal stage. This provides a new host record for the caterpillar, which has previously been reported from eggplant and other solanaceous plants, but not from pepper.

## DECEMBER 13, 1943

The 456th meeting was held at the H.S.P.A. Experiment Station on Monday, December 13, at 2:00 p.m., with President Holdaway in the chair.

*Members present:* Messrs. Bianchi, Carter, Faxon, Fullaway, Holdaway, Ito, Krauss, Look, Marlowe, McBride, McPhail, Nishida, Pemberton, Sakimura, Schmidt, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Wm. Craft, S. S. Ristich and T. C. Russell.

Mr. Kenneth Murakami was elected to membership; Mr. Zimmerman proposed the name of Mr. Wm. Craft for membership in the Society. On motion of Dr. Schmidt it was unanimously voted to instruct the Secretary to send a letter of thanks to the Hawaiian Sugar Planters' Association for financing the publication of the Society's Proceedings for 1942.

This being the annual meeting, a slate of officers to serve during the coming year was presented by the executive committee. There being no nominations from the floor, the slate was accepted and the following officers unanimously elected:

President.....	Richard Faxon
Vice president.....	N. L. H. Krauss
Secretary-treasurer.....	Dr. F. X. Williams
Additional members of executive committee.....	
.....	M. McPhail and Dr. C. T. Schmidt

## PAPERS

The following papers were presented: "Notes on Insects and Other Arthropods from the Islands of Molokai and Maui, Hawaii", by Mr. Krauss; "Thrips from Kauai", by K. Sakimura and T. Nishida; "Nesothrips Kirkaldy Supersedes Oedemothrips Bagnall", by Mr. Bianchi; and "Biological Studies in Hawaiian Water-loving Insects, Parts III D, IV and V", by Dr. Williams. Mr. Zimmerman presented two papers entitled: "Pembertonia, a New Genus of Papuan Cossoninae (Coleoptera, Curculionidae)" and "Two New Amblycnemus from Larat Island (Coleoptera, Curculionidae)".

## NOTES AND EXHIBITIONS

*Zaischnopsis* sp.—Mr. Swezey reported having reared 13 of these parasites from an egg cluster of *Holochlora japonica* (Brunner) eggs in an hibiscus twig collected in his garden on Lanihuli Drive, October 12, 1943. The parasites issued one to three per day over a period of 40 days from Oct. 18 to Nov. 29.

*Ephestia sericaria* (Scott)—Mr. Swezey exhibited a specimen of the Mediterranean flour moth which he had reared from a pecan nut December 13, 1943. An occasional infested nut was found in a pound of nuts obtained at a local fruit store. In each case, the nut was somewhat cracked allowing for the entrance of the small larva.

*Eucelatoria armigera* (Coq.)—Mr. Pemberton, commenting on Mr. Krauss' finding of this tachinid fly at Olinda, Maui on June 12 (see p. 89), spoke of the importance of this recovery and stated that adults of the fly were reared at the H.S.P.A. Experiment Station by Mr. Van Zwaluwenburg, and sent to Puunene, Maui on February 28 and March 8, 1943. These were liberated at Hawaiian Commercial and Sugar Company, Ltd. Since this conspicuous fly has never been previously collected on Maui, it is probable that its establishment on that island is the result of the introduction early this year.

*Ēriosoma lanigerum* (Hausmann)—Mr. Look exhibited specimens of an aphid, apparently the wooly apple aphid. They were collected alive from a green apple (Newtown pippin) on November 22, 1943. Fifteen apterous adults and nymphs were found breeding in the core. No alates were present. The apple, which was imported apparently from the west coast, was bought in the local market in November. Mr. Pemberton stated that during a visit to Keanakolu, Hawaii, on October 27, 1943, he observed an abundance of this aphid on old apple trees. This is at an elevation of about 4500 feet. Mr. Fullaway remarked that this aphid has long been known in Hawaii on apple trees.

*Some new host records*—Mr. Nishida reported the following instances of new food plant records: On May 9, 1943 loopers were collected from lettuce seedlings grown in the Hawaii Experiment Station greenhouse. Upon rearing, it was found that these were *Autographa brassicae* (Riley) instead of *Plusia chalcites* (Esper). This is of interest because *A. brassicae* is commonly associated with cabbage, or plants closely related to it.

On September 1, 1943 *Conocephalus saltator* (Saussure) was observed on green beans at Waimea, Kauai. Several of these grasshoppers were observed feeding on the blossoms. It was not possible to ascertain whether the feeding had any detrimental effect on the yield, because it appeared that the grasshoppers fed primarily on the corolla; the pistils and stamens were apparently uninjured. On December 1, 1943, a heavy infestation of *Coccus viridis* (Green) was observed in a small celery patch on South Street, Honolulu. The scales were observed on both the petiole and leaf.

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President Holdaway then delivered his presidential address entitled: "Insects of Vegetable Crops in Hawaii Today". His introductory remarks were as follow:

The meeting today—the 456th meeting of the Entomological Society—is the 38th annual meeting. I am very conscious of the honor bestowed on me by the Society in asking me to be its President during the past year, an honor which is greater because of the upheaval in world affairs through which we are passing and the important part that our science is playing in helping the survival of this nation and her allies.

In spite of the war our Society has continued to meet regularly as in the past; not a single meeting has been missed. Because of this the Society holds a unique place among the scientific bodies of the Territory. Moreover, attendance at meetings has been maintained at a high level, and many valuable observations and contributions have been made available for the mutual benefit of ourselves and our fellow workers elsewhere.

We have been pleased to welcome several visiting entomologists and others interested in entomology at our meetings. While the war has brought in its train certain restrictions of personal liberties, it has also brought to our midst many entomological workers whom we have been pleased to have with us.

In recent years many insects not formerly present in the Territory have been discovered here and some, formerly of insignificance, have become important. The list of common names proposed by the Society in 1913 has thus been inadequate for the needs of entomological workers and agriculturists of today. In 1939 the Society appointed a committee consisting of D. T. Fullaway, F. G. Holdaway, O. H. Swezey and E. C. Zimmerman to compile a new list of common names adequate to the needs of the day, and, in the light of present knowledge, accurate as regards technical names. The committee had brought its studies to an advanced stage when the war hit us, and active work on the list had to be discontinued for a time. The need for public and popular dissemination of information on insects has, however, become even more necessary than in the past. In March 1943 the committee made its tentative list available in mimeographed form to entomological workers and other interested persons. Throughout the year the committee has continued to work on the list, revising, correcting and adding. Almost every technical name, authority and common name has been the subject of special and detailed study. The committee has appreciated the assistance given by several members of the Society who have contributed their time and specialized experience towards making the list as complete and accurate as possible in the light of present knowledge. The list, which now contains 330 names, is ready for final approval by the Society. I hope that the incoming executive committee will see its way clear to publishing the list in three different arrangements, with the common name first, with the technical name first, and according to orders.



## Nesothrips Kirkaldy Supersedes Oedemothrips Bagnall

BY FRED A. BIANCHI

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of December 13, 1943)

In 1907, three years previous to the appearance of Bagnall's monograph of the Thysanoptera of the Hawaiian Islands, (Fauna Hawaiiensis, 3 (6): 669-704, 1910) G. W. Kirkaldy erected the genera *Agnostochthona* and *Nesothrips*, each represented by a single species. The descriptions appeared together ("On Two Hawaiian Thysanoptera", G. W. Kirkaldy, Proc. Haw. Ent. Soc., 1: 102) and constituted the first published reference to the Thysanoptera of these islands. They were later incorporated in Bagnall's monograph, but it was therein stated in the case of *Agnostochthona*, and implied in the case of *Nesothrips*, that Bagnall had not examined the type material on which the genera were founded. It was also indicated, at least by implication, that to Bagnall neither of the descriptions seemed adequate. How just that indication may have been in regard to *Agnostochthona* may never be ascertained, as Kirkaldy failed to state the disposition of his type material and with his passing it was lost to science. In regard to *Nesothrips*, the writer is now able to establish beyond question that Bagnall's distrust of Kirkaldy's description was entirely justified.

After being lost for many years the types of *Nesothrips* have again come to light. Some time before his death, the late E. M. Ehrhorn had informed the writer that years earlier he had mounted Kirkaldy's originally pinned specimens intending to study them, but that he had later misplaced the slide and had been unable to find it again; and now that slide, fully and plainly labelled, has been found. It was one of an accumulation of old slides which the courtesy of Noel Krauss of the Territorial Plant Quarantine Station has enabled the writer to examine. Consisting of a balsam mount of two specimens under the same cover, it is sufficiently clear to permit unmistakable identification of the specimens as a male and a female of the species which Bagnall (Fauna Haw., 3 (6): 680) called *Oedemothrips laticeps* and upon which he erected the genus of the same name. Therefore, unjust as it must seem to anyone even carelessly glancing over Kirkaldy's description, the rules of taxonomy now demand the following revision:

*Oedemothrips* Bagnall 1910, becomes *Nesothrips* Kirkaldy, 1907.

*Oedemothrips laticeps* Bagnall 1910 becomes *Nesothrips hawaiiensis* Kirkaldy 1907.

The genus *Oedemothrips* or, by its new name, *Nesothrips*, is represented in our Territory only by the type species, and elsewhere only by the species *brevicollis* Bagnall in Japan, *propinquus* Bagnall in Australia, *propinquus* var. *brevipes* Bagnall in New Zealand, and *ceylonicus* Karny in Ceylon. Although not a genus of economic significance, the wide geographical distribution of its few species makes it one of interest. It does not seem superfluous, therefore, to present here a fuller description of the type species than has yet been accorded any of the others.

1907 *Nesothrips hawaiiensis* Kirkaldy. Proc. Haw. Ent. 1: 103.

1910 *Oedemothrips laticeps* Bagnall. Fauna Hawaiiensis; 3 (6): 680.

Female (apterous): General color by transmitted light, dark brown to black; fore tibiae, all tarsi, base of third antennal segment, light translucent brown; a nearly black area showing on all tarsi near the distal end. Hypodermal pigment shows as red blotches through the transparent intersegmental membranes when these are stretched. Weak striation of the chitin is discernible only in caustic-treated specimens and is stronger on the sides of the head and disk of the metanotum than elsewhere. The pattern of striation is transversely reticulate.

Head 258 microns along mid-dorsal line from base to vertex; 273 microns wide just back of the eyes. Eyes together occupying one half of head width; separately, one fourth of head length along the margin. Sides converge weakly from eyes to slight collar-like thickening of chitin at base of head. Post-oculars long, not unusually thick, inserted well back from the eyes, slightly farther out from the mid dorsal line than the inner edge of the eyes. Inter-oculars somewhat longer than half the length of post-oculars, well in from the inner margin of the eyes on a line about a third of the eye length from their front margin. On the same line but very close to the eye margin another seta, very minute and difficult to observe but present in all specimens. Back of the post-oculars and nearer the mid-dorsal line, two other setae, much smaller than the interoculars but always conspicuous. Other small, possibly paired, setae on the cheeks cannot be accurately located on the dorso-ventral mounts available. The inner margin of the eyes in dorsal view is angularly rounded; the outer follows the outline of the head, not protruding and comprising about eight of the rather coarse facets, between which there is no pilosity. Ventrally the eyes are produced posteriorly and their outline is ellipsoidal, flattened at one end and constricted in the middle. The frons is produced into a flat rectangular plate which bears five pairs of setae: a very long pair forward, near the bases of the antennae, an equally long pair just above the base of the mouth cone, two minute and inconspicuous pairs between the latter and the transverse median line, and a somewhat longer pair above the median line and farther apart than the others. On each side of the frons, between the bases of the antennae and the eyes, there are two other paired setae, of which the upper one is the longer. The mouth cone is short, evenly rounded, reaching about two thirds of the way across the prosternum, bearing a pair of thin setae between the bases of the maxillary palpi. Maxillary palpi well developed, arising from shallow ovate depressions in which, semicircularly arranged, there are three or four setae with conspicuous bases; the basal segment short, about one fourth the length of distal segment, which tapers only slightly to a blunt tip armed with two or three thick, short, light-

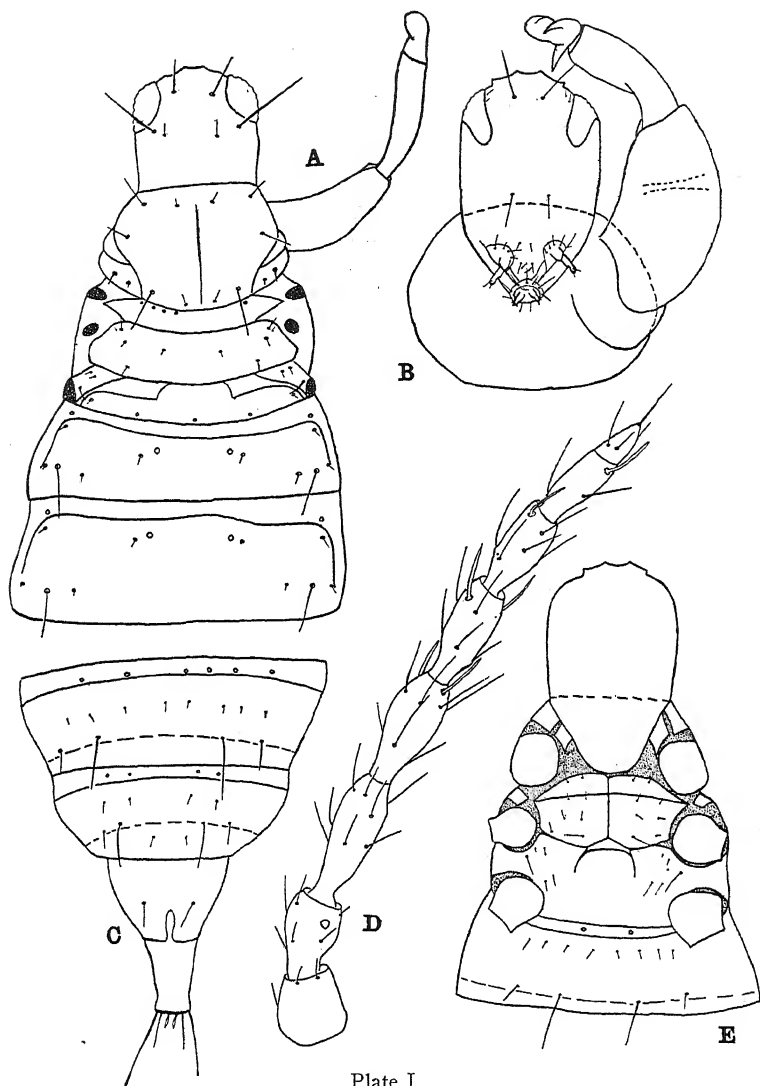


Plate I

*Nesothisrips hawaiiensis*

- A—Dorsal view of ♀, head, thorax, first and second abdominal segments.
- B—Ventral view of ♂, showing mouth parts and location of transverse invagination of cuticle on dorsal surface of femur.
- C—Ventral view of ♀, 7th, 8th, 9th and 10th abdominal segments.
- D—Dorsal view of right antenna, ♀.
- E—Ventral view of ♀, thorax and first abdominal segment. Setae of coxae and head not shown.



colored setae. The labrum, rather broadly tipped, does not protrude beyond the labium. The labial palpi are unusually small, irregularly cylindrical, armed with short setae; their segmentation not discernible. The distal edge of the labium is thick and curves around and behind the labial palpi and the tips of the labrum and maxillae, almost meeting in front and bearing six to eight long hairs which are regularly spaced and form a distinct circlet at the tip of the mouth cone.

Antennae eight segmented, approximate at base, twice as long as head, concolorous with body; by transmitted light segment three paler on basal third and showing dark transverse wrinkles; all segments except one bearing long, thin, translucent hairs arranged more or less in whorls, one below and the other above the transverse median line; segment one bearing no sense cone or sense pit and only one long hair on the inner side; segment two bearing a conspicuous sense pit dorsally near the distal margin; segment three bearing two sense cones ventrally; segment four, two dorsally; segment five, one on each side; segments six and seven, one dorsally; segment eight without sense pits or cones but with a long, thick hair at its tip. Sensory cones translucent, about half as long as segments bearing them, always borne near distal lip of segment, narrowing towards tip but not sharply pointed.

Prothorax 197 microns long; as wide as head in front; widening gradually to about middle, then smoothly rounded at hind angles to hind margin. Median suture dark, conspicuous, not reaching front or hind margin. Pronotal plate large, extending across prothorax in front, narrowing bisinuate towards the hind margin, making room at each hind angle for two other plates, the smaller of which is triangular and lies in front of the larger, which is trapezoidal and bears a thick short seta. Pronotal plate bears a long, strong seta at each hind angle; eight others, much smaller, as follows: four equally spaced on the fore margin, two on the hind margin, one on each side near the transverse median line. Also visible in dorsal view of the prothorax, there is on each side a short, thick, translucent bristle which is really inserted on the side of the fore coxa.

Prosternum chitinized only on shoulders and along caudal margin, a wide area of granulose membrane occupying the central portion, which is broadly indented to receive the mouth cone, and narrower bands curving about the bases of the fore coxae. A small, approximately rectangular sclerite occupies the front angle of the segment and a similarly shaped sclerite lies just inward from and slightly caudad of the first, their caudal margins forming a continuous curve in front of the coxa. Two sclerites joined along the midline to each other and along their straight caudal margins to the sclerites of the mesosternum form a plate that lies between the coxae and does not reach the disk of the segment; its front margin is arcuate and slightly indented on the midline where the two sclerites join and it bears four minute setae, two on each sclerite.

Pterothorax but little wider than prothorax and only 167 microns long; in mounted specimens appearing from dorsal view evenly outlined on sides, but probably not so in life, as the ventral plates of the segment are distinctly wider than the dorsal plates. Stigmata large and conspicuous; an elongate oval one placed dorso-ventrally on the fore angles of the mesothorax; a nearly circular one, dorsally on each side of the metathorax. Mesoscutum is short, sloping downward in front; its caudal margin straight and considerably shorter than the cephalic margin; its sides diverging anteriorly; bearing four exceedingly minute setae along posterior margin and a transverse row of five irregularly placed, circular pits near the transverse median line. Scutum and scutellum of metathorax fused without indication of suture; forming a roughly rectangular plate slightly wider and considerably longer than mesoscutum; its caudal and cephalic margins straight; its hind angles rounded; its front angles emarginate to fit around the metathoracic spiracles;

bearing two setae, one minute, on each end, above the spiracle, two longer ones on the hind margin, equidistant from the middorsal line, and a row of four minute ones on the transverse median line.

Mesosternum transversely rectangular; strongly curved on the sides to fit around middle coxae; weakly arcuate behind and the hind edge deeply and broadly invaginated in the center; curving sharply upwards along entire cephalic margin to join prosternum, which lies on a higher horizontal level than the rest of the ventral surface of the insect; divided into two side plates by a strong, straight median suture which is interrupted in back by the broad invagination of the caudal margin; each side plate bearing six small setae, two paired near the front margin, two on the median transverse line, and two, of which the inner is much longer than the outer, near the caudal margin. A small trapezoidal plate, the episternum, curves upwards on each anterior angle, just ahead of mesothoracic spiracle and is entirely separate from the mesosternum.

Metasternum transverse; considerably longer than mesosternum; weakly concave in front margin; almost straight caudally; narrowed and curving upwards on the sides between the middle and hind coxae; its front angles deeply excavate to curve around the middle coxae; its hind angles likewise curving around hind coxae; its front margin interrupted on either side of median line by a short, narrow, deep, longitudinal invagination of the chitinous disk of the segment; bearing on either, between the middle and hind coxae and almost on a median transverse line a long, strong seta, and inwards from this four much smaller ones, a pair cephalad and a pair caudad.

Legs in relation to size of body rather long but not unusually stout; the hind pair somewhat longer than the others; the front pair differing only in the relatively thicker femur; the coxae subconical, bearing several small setae but only the front pair with a conspicuous, thick, translucent seta on the outer side; the femora and tibiae bearing many dispersed, rather stiff setae which are generally longer on the distal third of the tibiae, and in addition a long thin, pale bristle outwardly on the distal end of the tibia and a similar one inwardly near the base of the femur. Tarsi two segmented; bearing several short, stiff, colorless setae; the division between segments oblique; the distal segment longer, with an almost black blotch on the ventral surface, bearing near the distal end, on what is the front surface as the insect walks, a strongly recurved claw which does not extend beyond the end of the segment.

Abdomen in relation to rest of body very large, in distended mounts twice as long as rest of body, elliptical in outline; of same width as pterothorax at base of first segment, widening rather suddenly to third segment, which is the widest and longest, narrowing gradually to fourth, thence more suddenly to base of tube. First abdominal segment shorter than metathorax, equally wide on front margin but considerably wider behind; its sides strongly convergent in front but parallel on their caudal halves, which are occupied by the upper portions of large spiracles placed dorso-ventrally on the sides of the segment; dorsally covered by three distinct plates, one roughly triangular occupying the base and central portion of the dorsum, two smaller ones, also triangular, occupying the anterior angles; the space between the chitinized plates occupied by a roughly granulose membrane; each side bearing three or four scattered, minute setae, and next to the spiracle a much stronger and conspicuous one; the central plate bearing a minute seta on each end near the hind margin and three equally spaced circular pits on a line joining the setae. Second segment is trapezoidal, with sides converging forward; three to six practically rectangular; seven, eight, and nine also trapezoidal but their sides strongly convergent caudally. On segments two to eight an area of heavier chitinization forms a plate which is broadly margined in front and back and narrowly margined on the sides by bands of weaker chitin that caudally merge into a broad granulose membrane. The cephalic margin of the plate is much more heavily chitin-

ized than the rest and appears in cleared specimens like a thin black line. The chaetotaxy of segments two to eight homologous, as follows: a small circular pit on each angle and one on each side of the mid-dorsal line, nearer to the cephalic than to the caudal margin of the segment; approximately in line with the latter but not always exactly so, four minute setae, two close to the circular pits and the other two near the side margins of the segment; on a transverse line cephalad about a third of the segment's length from the hind margin, six setae, three on each side, the inner minute in all the segments, the middle one relatively long in all the segments except eight, the outer one minute on segment two but gradually increasing until on segment seven it is the longest bristle on the body; on segment eight only the outer seta long, the two inner ones small. On segment nine the pits on the fore angles are not discernible in dorso-ventral mounts; the other two circular pits are larger and more widely spaced, being near the outer margins of the segment; of the three setae on each hind angle the middle one is small, the other two as heavy or heavier than the setae on segment seven but not as long. The eighth segment bears on the middle of each side a round spiracle, smaller than the thoracic ones and visible in dorso-ventral mounts only by deep focusing. The tube is characteristically stubby, about two-thirds the length of the head and about one half as wide at the end as it is at the base; the sides parallel on basal eighth, which is inserted in the ninth segment and visible only by transmitted light, then converging towards and roundly constricted just before the end; bearing on the caudal lip a circlet of six bristles longer than the tube and seven about half as long which alternate regularly on the dorsum and sides but not ventrally, where on either side of the dorso-ventral axis there is a shorter, characteristically sword-shaped seta.

The ventral arrangement of the abdominal segments is homologous from the first to the eighth. Each segment consists of a wide transverse band of chitin outlined in front by a thin black line of heavier chitination, and margined narrowly in front and broadly behind by bands of coarsely granulose membrane. On the membrane in front is borne a row of circular pits; two on segment one, each flanked by a minute seta, six more or less regularly spaced on segments two to seven, four on segment eight. Near the cephalic margin of the chitinated band and reaching nearly from side to side is borne a transverse row of minute setae, from 8 to 12 on segments one to seven and only 4 on segment eight. On the caudal margin of the chitinated band is another row of four setae which are short and weak on segments one to five but become more than half as long as the segment on six to eight, the middle pair on these segments and on segment one being much longer than the outer. Unparalleled on the other segments, there are two minute setae on the caudal membrane of segment eight, one on either side of the midline. The caudal margin of segment nine is deeply, widely, bisinuatly indented on the midline to form the genital opening, and on either side of the opening nearly on the transverse median line is a fairly long and strong seta.

Measurements of female holotype in mm., followed by measurements of metatype in parentheses, except in case of the setal measurements, which could not be obtained from the poorly mounted holotype and were all made on a metatype: Length about 2.35 (.2128); length of head .258 (.228); width across cheeks .273 (.228); median length of pronotum .197 (.182); greatest width of pronotum, including fore-coxae .410 (.334); median length of pterothorax .167 (.122); greatest width of pterothorax .516 (.410); greatest width of abdomen (segment III) .714 (.577); median length of tube .167 (.153); width of tube at base .105 (.091); width of tube at end .055 (.045); postocular setae .100; interocular setae .058; setae on anterior angles of prothorax .036; lateral setae on prothorax .048; outer setae on posterior angles of prothorax

.033; inner setae on posterior angles of prothorax .094; setae on 7th abdominal segment .183; setae on ninth abdominal segment .100; longest setae at end of tube .143.

Antennal segments	1	2	3	4	5	6	7	8	Total
Metatype	.0336	.0550	.0856	.0856	.0765	.0642	.0489	.0336	.483
Holotype	.0451	.0615	.1025	.0820	.0820	.0697	.0574	.0328	.533

Male (apterous): Not essentially different from the female except as follows: Somewhat smaller; length about 1.67 mm. (not distended). The prothorax is relatively longer and wider and its sides instead of converging forward are evenly rounded. The disk of the prosternum instead of being wholly membranous is occupied by two small thinly chitinized plates, more or less triangular in shape and separated from the two basal plates and from each other by thin sutures, from the fore-coxae and the shoulder pieces by narrow bands of granulose membrane. The fore-coxae occupy a relatively larger portion of the prosternum and their thick translucent setae are relatively smaller than in the female and not visible in dorsal view. The fore-femora are strongly incrassate; the chitin of their dorsal surface narrowly but deeply folded into a transverse invagination just distal of the median-transverse line. The caudal segment of the fore-tarsus is produced inwardly into a strong claw extending well beyond the margin of the fore-tibia. The ventral and dorsal chaetotaxy as in the female, but the structure of the ninth abdominal segment and the tube modified in the usual tubuliferan manner. Ventrally the discal portion of the ninth segment is joined to the base only, being more or less arcuately cut off from the sides into a scale which reaches farther back than the straight dorsal margin of the segment and overlaps the base of the tube. The base of the tube is straight dorsally but arcuately emarginated ventrally.

Measurements of male (metatype) in mm.: Length of head .258; width of head .243; length of prothorax .241; width of prothorax .425; width of fore-femur (transverse median line) .168; maximum width of abdomen (third segment) .562; width of tube at base .113; width of tube at end .045; length of tube .184; postocular setae .110; interocular setae .072; inner setae at posterior angles of prothorax .123; outer setae at posterior angles of prothorax .028; longest (outer) setae on the 7th segment .184; longest setae on the 8th segment .082; longest setae on the 9th segment .09; longest setae at end of tube .184.

Antennal segments	1	2	3	4	5	6	7	8	Total
	.0492	.0574	.0984	.0861	.0820	.0615	.0533	.0369	.524

Described from the following material which, to the author's knowledge, comprises all the collections ever made in the Territory, with the exception of Bagnall's:

- 1—The ♀ holotype: O. H. Swezey, collector; "probably on flowers"; Mt. Tantalus, Oahu; August 12, 1906; now in the collection of the Experiment Station, H.S.P.A.
- 2—The ♂ allotype: on the same slide as the holotype and with the same data.
- 3—One ♂: E. C. Zimmerman, collector; beating; Palikea, Wai-anae Mts., Oahu; November 2, 1936; in the Bishop Museum.

- 4—One ♀: N. H. Krauss, collector; beating; Waikolo valley region, Molokai; 3,500 ft. elevation; October, 1943; in the collection of the Pineapple Research Institute.

## The Hawaiian Species of *Enicospilus* and *Abanchogastra* (Hymenoptera: Ichneumonidae)

BY R. A. CUSHMAN

Bureau of Entomology and Plant Quarantine, Agricultural Research Administration,  
United States Department of Agriculture

(Presented at the meeting of September 13, 1943)

The species of *Enicospilus* indigenous to the Hawaiian Islands form a very distinct group within the genus, characterized by a peculiarly fine, mat sculpture, especially of the thorax, and exhibiting wide variation in color and a marked tendency in several of the species to break up into size-races and color-races. A considerable number of these variations have been described as distinct species and some later synonymized. All have the head with the same basic yellow or whitish color pattern embracing the orbits, face, and clypeus, usually the vertex, and rarely almost the entire head; in red forms the pattern is sometimes suppressed by lack of contrast, and rarely in dark forms it is largely reduced by the encroachment of the dark color. It should be noted that the dark color of none of the species is a true black but results from the addition of more or less black pigment to the typical ferruginous color.

Only three authors—Cameron, Ashmead and Perkins—have described Hawaiian species, and of these only Perkins had anything like a clear understanding of them. The last-named author<sup>1</sup> has made a very critical study of large numbers of specimens, and has summarized admirably the variation occurring in most of the species, especially in size, in color, and in the strength of the propodeal carina. It is unnecessary here to discuss this matter further. Suffice it to state that in order to identify species with certainty it is necessary to ignore color almost entirely, except in a few species, and depend upon structure. Among the most useful characters are the size, shape and position of the fenestra and of its scleromes, the former very constant, the latter variable, except for position, in most species; the degree and position of the thickening of the basal abscissa of the radius; the course and thickness of the discocubitus and the length of the second recurrent in relation to the basal abscissa of the subdiscoideus and the angle formed by these two veins and the consequent shape of the second discoidal cell; the relative lengths of the veins of the transverse brace (intercubitus, second abscissa of cubitus and second recurrent); the convexity of

<sup>1</sup> Fauna Hawaiiensis, I,(6), Introduction: cix-cx, 1913, and Trans. Ent. Soc. London, 1914: 521-535, 1915.

the eyes and length of the malar space with the resulting effect upon the shape of the head; the degree of attenuation of the abdomen; the form and length of the ovipositor; the form of the aedeagus; and the form of the apical tarsal joints, especially in the male. By the use of these characters the Hawaiian species can be divided into several groups, some already described as distinct genera, but apparently of not more than subgeneric status.

Previously published descriptions of the color and Perkins' analysis of the variation in color, size and some features of structure and sculpture render detailed descriptions of the species unnecessary. Descriptive matter in the following discussion of the species is confined largely to that referring to the fenestra and its scleromes and the shape of the second discoidal cell. These structures furnish the most reliable specific characters that I have found in the Hawaiian species. The other characters of the venation mentioned above, mostly subject to some variation, are brought out in the figures.

All the figures are from drawings by my son, Arthur D. Cushman, of the Bureau of Entomology and Plant Quarantine.

Including the two species described in *Pleuroneurophion* and the one in *Eremotylus*, 25 names have been applied to Hawaiian species of *Enicospilus*, as follows:

*Pleuroneurophion hawaiiensis* Ashmead.

*P. ferrugineus* Perkins.

(*Eremotylus*) *Eremotyloides orbitalis* (Ashmead).

(*Ophion*) *Enicospilus lineatus* (Cameron).

(*Ophion*) *Enicospilus nigricans* (Cameron), preoccupied by *Ophion nigricans* Ruthe, and renamed *Enicospilus nigrifolius* Morley. Synonymized by Perkins with *castaneus* Ashmead.

*Enicospilus mauicola* Ashmead.

*Enicospilus kaalae* Ashmead.

*Enicospilus waimeae* Ashmead.

*Enicospilus variegatus* Ashmead.

*Enicospilus nigrolineatus* Ashmead.

*Enicospilus castaneus* Ashmead.

*Enicospilus henshawii* Ashmead. Synonymized by Perkins with *lineatus* (Cameron).

*Enicospilus molokaiensis* Ashmead.

*Enicospilus longicornis* Ashmead.

*Enicospilus semirufus* Perkins. Synonymized by Perkins with *kaalae* Ashmead.

*Enicospilus dispilus* Perkins.

*Enicospilus dispilus* var. *pallipes* Perkins.

*Enicospilus dimidiatus* Perkins. Synonymized by Perkins with *mauicola* Ashmead.

*Enicospilus tyrannus* Perkins.

*Enicospilus capnodes* Perkins. Synonymized by Perkins with *maucicola* Ashmead.

*Enicospilus melanochromus* Perkins.

*Enicospilus funereus* Perkins.

*Enicospilus ashmeadi* Perkins.

*Enicospilus bellator* Perkins.

*Enicospilus pseudonymus* Perkins.

To these I am adding two new species, both in the subgenus *Eremotyloides*.

Among the more than 400 specimens that I have examined, including those in the United States National Museum and a lot kindly sent me by Elwood C. Zimmerman of the Bernice P. Bishop Museum in Honolulu (some identified by Perkins) I have recognized all but four of the species listed above. Of these four, *ferugineus* Perkins and *pseudonymus* Perkins are placed in the following key on characters given in the original descriptions; and of the other two (*funereus* Perkins and *tyrannus* Perkins) the probable or possible positions are indicated.

The holotypes of all species of Ophionini described by Cameron, Ashmead, and Perkins (except that of *Pleuroneurophion hawaiiensis* Ashmead, which is in the United States National Museum) are in the British Museum.

In the key and discussions the terms *fenestra* and *sclerome* correspond to Perkins' terms "hyaline glabrous area of the discocubital cell" and "chitinous spot of the discocubital cell."

#### KEY TO HAWAIIAN SUBGENERA AND SPECIES OF ENICOSPILUS

1. Fenestra more or less distinct; mesoscutum of normal conformation .....2
- Fenestra lacking; mesoscutum "somewhat strongly compressed at the sides in such a way that the middle third of its width appears elevated" .....(♂) 17. *pseudonymus* Perkins.
2. Abdomen extremely slender, tergites 1-5 in female, 1-4 in male, longer than deep (fig. 17); ovipositor very short, stout, and recurved (fig. 17); (aedeagus as in fig. 2a) (subgenus *Eremotyloides* Perkins) .....3
- Abdomen less conspicuously slender, tergite 4 in both sexes deeper than long; ovipositor straight and not especially short, rarely strongly exserted .....5
3. Basal abscissa of radius straight, thickened only in about basal third; fenestra small, not extending beyond the thickening; sclerome, when present, broadly oval and lying along proximal margin of fenestra (figs. 1 and 2) .....4
- Basal abscissa of radius with a slightly curved thickening occupying more than its basal half; fenestra large, embracing fully half the apical portion of the discocubital cell; sclerome long and narrow and lying along lower margin of fenestra (fig. 3) .....3. *fullawayi*, new species.



4. Fenestra without sclerome (fig. 1); second abscissa of cubitus thrice as long as intercubitus (fig. 1); metapleura moderately convex (fig. 21).....(♀ ♂) 1. *orbitalis* (Ashmead).  
 One sclerome present, the proximal, this rather large, oval, with its long axis vertical to costal margin (fig. 2); metapleura conspicuously convex (fig. 22).....(♀ ♂) 2. *perkinsi*, new species.
5. Discocubitus sharply angled and with a short, thick ramellus; fenestra extremely small, below base of radius, usually with a very minute, colorless proximal sclerome on lower proximal margin (fig. 4); ovipositor prominently exerted (fig. 18); (aedeagus as in fig. 4a) (subgenus *Pleuroneurophion* Ashmead).....6  
 Discocubitus at most weakly angled and without ramellus; fenestra not as above; ovipositor not exerted (subgenus *Enicospilus* Stephens).....7
6. Dark brown.....(♀ ♂) 4. *hawaiiensis* (Ashmead).  
 Ferruginous.....(sex?) 5. *ferrugineus* (Perkins).
7. Fenestra occupying fully three-fourths width and nearly half area of narrow distal portion of discocubital cell, with one sclerome, the proximal, which is small, oval or pyriform, and on lower proximal margin of fenestra, closer to discocubitus than to radius and basal of a line drawn perpendicular to costa through base of radial cell (figs. 5-7); female hypopygium very prominent (fig. 19).....8  
 Fenestra smaller and narrower, proximal sclerome, when present, closer to radius than to discocubitus, usually distad of base of radial cell (figs. 8-15), female hypopygium not especially prominent (fig. 20).....10
8. Discocubitus at least slightly thickened at junction of first recurrent and cubitus and sometimes slightly angled (figs. 5 and 6).....9  
 Discocubitus neither thickened nor angled (fig. 7).....  
 .....(♀ ♂) 8. *kaalae* Ashmead.
9. Thorax laterally mat, densely ruguloso-punctate to rugulose; discocubitus usually angulate (fig. 5); aedeagus as in fig. 5a; ferruginous.....(♀ ♂) 6. *molokaiensis* Ashmead.  
 Thorax laterally shining, very minutely alutaceous and finely irregularly aciculate and sparsely punctate; discocubitus not angulate (fig. 6); aedeagus as in fig. 6a; dark.....  
 .....(♂) 7. *melanochromus* Perkins.
10. Fenestra small, usually about as long as broad, not or barely a third as long as basal abscissa of radius (figs. 8-9, 11-13), rarely (*bellator*, fig. 10) represented only by a narrow hairless area along radius; aedeagus as in figs. 8a and 11a.....11  
 Fenestra rather large, fully half as long as basal abscissa of radius (figs. 14 and 15); aedeagus as in figs. 14a and 15a.....16
11. Scutellum transversely flat between carinae, very densely punctate or rugulose and dull, carinae usually prominent; length of malar space at dorsal articulation of mandible, at least in female, nearly or quite half as long as basal width of mandible; apical tarsal joint in male (fig. 24) strongly depressed, parallel-sided or even broader toward base than at apex.....12  
 Scutellum transversely convex between carinae, more sparsely punctate and usually more or less shining, if dull the surface very finely mat and with well separated punctures, carinae not unusually prominent; malar space distinctly less than half as long as basal width of mandible; apical tarsal joint (fig. 25) broadening toward apex and not especially depressed.....14

12. Fenestra not exceptionally small, usually with a well defined proximal sclerome and frequently a trace of a central sclerome, rarely without scleromes (figs. 8 and 9).....13
- Fenestra very small and narrow with no proximal sclerome, but with a faintly sclerotized lower margin (fig. 10).....  
.....(♀ ♂) 11. *bellator* Perkins.
13. Head distinctly elongate, apparently longer from vertex to apical margin of clypeus than broad, eyes rather shallowly convex, malar space in female more than half, in male about half, as long as basal width of mandible; fenestra with only the proximal sclerome (fig. 8), rarely without any; antenna, especially in female, unusually short.....(♀ ♂) 9. *castaneus* Ashmead.  
Head broader than long, eyes deeply convex, malar space in female barely, in male less than, half as long as basal width of mandible; fenestra with large proximal and small central sclerome (fig. 9); antenna long.....(♀ ♂) 10. *dispilus* Perkins.
14. Thorax, legs, and abdomen not contrastingly colored, mostly dark or mostly red; scutellum finely punctate and more or less shining .....15  
Thorax and legs yellowish and black; abdomen dark with dorsal edge yellow; scutellum coarsely punctate and mat.....  
.....(♀ ♂) 14. *variegatus* Ashmead.
15. Sclerome very large, nearly equal to fenestra in area (fig. 12).....  
.....(♀ ♂) 13. *waimeae* Ashmead.  
Sclerome much smaller, sometimes lacking (fig. 11).....  
.....(♀ ♂) 12. *lineatus* (Cameron).
16. Fenestra with only one sclerome, the proximal, this distinctly distad of a line perpendicular to costal margin through base of radial cell, elongately triangular and with a more or less distinct appendix to apex of fenestra (fig. 14); yellowish, with prescutum, mesosternum and propodeum largely black; aedeagus as in fig. 14a.....(♀ ♂) 15. *nigrolineatus* Ashmead.  
Fenestra with two scleromes, the proximal almost equilaterally subtriangular without appendix and basad of a line perpendicular to costal margin at base of radial cell and a central sclerome irregularly elongate or subovate (fig. 15); ferruginous, at most with piceous stains on thorax; aedeagus as in fig. 15a.....  
.....(♀ ♂) 16. *longicornis* Ashmead.

### Subgenus *Eremotyloides* Perkins

*Eremotyloides* Perkins, Trans. Ent. Soc. London, 1914: 530, 1915.

Genotype.—*Eremotylus orbitalis* Ashmead (p. 532). Monobasic.

This subgenus differs from the typical subgenus virtually only in the extreme slenderness of the abdomen (sometimes less evident in the male) and in the short, recurved ovipositor (fig. 17). Its status as a subgenus may be found to be untenable when the *Emicospilus* fauna of the world is studied, but within the fauna of the restricted area it differs so conspicuously from the bulk of the species that it seems well to recognize it.

1. **Enicospilus (Eremotyloides) orbitalis** (Ashmead), new combination

*Eremotylos orbitalis* Ashmead, Fauna Hawaiiensis, 1 (3): 345, 1901.

*Eremtyloides orbitalis* (Ashmead), Perkins, Trans. Ent. Soc. London, 1914: 532, 1915.

Of this species I have seen three males and one female, each from a different island: Hawaii, Koebele; Oahu, Waianae Mts., 2,500 feet, May 1892, Perkins; Kauai, Mts. Waimea, 4,000 ft., 1894, Perkins; Maui, Honomanu, June 28, 1920, E. H. Bryan, Jr.; the first three in the United States National Museum, the last in the Bernice P. Bishop Museum.

All these specimens are dark, but Perkins records specimens with red thorax and pale legs, and suggests the possibility of there being an entirely pale form.

The sculpture of the thorax in this species is notably finely and evenly alutaceous and mat, with very little tendency to rugulosity except on the propodeum, where it is very fine. The second discoidal cell (fig. 1) is notably short and broad, with the discocubitus strongly arched and the second recurrent much more than half as long as the basal abscissa of the subdiscoideus. The radius is thickened only in about its basal third, and the fenestra is very small and rather poorly defined and lacks all trace of scleromes.

2. **Enicospilus (Eremotyloides) perkinsi**, new species

Very distinct from *orbitalis* in the possession of a rather large, dark-colored sclerome and from all recorded specimens of that species in its largely or entirely bright ferruginous color.

*Female* (holotype).—Length 19.0 mm., antenna 12.0 mm., forewing 11.0 mm.

Much more shining than *orbitalis* and virtually lacking the very fine alutaceous sculpture characteristic of that species.

Face sparsely punctate, slightly wider at level of clypeal foveae than frons; clypeus punctate only basally; head elsewhere polished. Pronotum obliquely striate laterally; mesoscutum subpolished, very finely and sparsely punctate discally; scutellum rather strongly convex between carinae, very finely alutaceous and more coarsely punctate than mesoscutum; mesopleuron and metapleuron striato-rugulose, metapleuron prominently convex (fig. 22); prepectus striato-punctate; mesosternum sparsely punctate; propodeum without carina, finely mat basad of normal position of carina, irregularly rugose apicad, slightly impressed medially. Forewing (fig. 2) with basal abscissa of radius strongly swollen in basal third; fenestra very small, at extreme base of radius, with dark, broadly oval, and sharply defined proximal sclerome with long axis nearly perpendicular to costal margin; intercubitus two-thirds as long as second abscissa of cubitus, which is somewhat longer than second recurrent; discocubitus arched in middle so that discoidal cell is wider there than at apex; nervulus distinctly antefurcal; nervellus broken somewhat below middle. Legs, especially femora, rather stout, coxae and femora shin-

ing, very minutely sculptured. Abdomen (fig. 17) shining, nearly three times as long as head and thorax combined, exceedingly slender, fifth tergite distinctly longer than deep, hypopygium extending slightly beyond apex of last tergite so that sheath is directed somewhat dorsocephalad; ovipositor short, stout basally, recurved.

Bright ferruginous; head almost uniformly colored; abdomen blackish from near base of third tergite to apex.

*Male* (allotype).—Essentially like holotype. Aedeagus as in fig. 2a.

*Type locality*.—Kokee, Kauai.

*Holotype and allotype*.—Bernice P. Bishop Museum.

*Paratypes*.—No. 56660, United States National Museum.

Two specimens of each sex, all from Kauai, the holotype taken at light July 6, 1937, by E. C. Zimmerman; the allotype, in September, B. P. Clark; the female paratype at 4,000 ft. April 28, 1919, J. A. Kusche; and the male paratype at Kaholuamano, April 1920, J. A. Kusche.

In the female paratype the dark color on the abdomen is very dilute, and the two males are intermediate in this respect.

### 3. *Enicospilus* (*Eremotyloides*) *fullawayi*, new species

*Female*.—Length 19.0 mm., antenna 12.0 mm., forewing 11.0 mm.

Extremely similar in habitus, structure, sculpture, and color to *orbitalis*, and differing virtually only by the following characters:

Thickening of radius (fig. 3) gently curved and occupying nearly two-thirds of the length; fenestra very large, occupying about three-fourths the width and fully half the area of apical portion of discocubital cell; proximal sclerome linear and lying along lower margin of fenestra at proximal end entirely proximad of a line through base of radial cell perpendicular to costal margin, second discoidal cell rather narrow, discocubitus gently arched, second recurrent distinctly less than half as long as basal abscissa of subdiscoideus.

*Type locality*.—Halemanu, Kauai.

*Holotype*.—No. 56661, United States National Museum.

A single female captured June 8, 1919, by H. T. Osborn.

#### Subgenus *Pleuroneurophion* Ashmead

*Pleuroneurophion* Ashmead, Proc. U. S. Nat. Mus. 23: 86, 1900; Fauna Hawaiensis, 1(3): 342, pl. 9, fig. 1, 1901; Perkins, Trans. Ent. Soc. London, 1914: 521, 529, 1915.

*Genotype*.—*Pleuroneurophion hawaiiensis* Ashmead.

Both the angulate and thickened discocubitus and the very small fenestra situated at the very base of the radius (fig. 4) characteristic of this subgenus occur elsewhere in *Enicospilus*, usually not in combination. Among the Hawaiian species the angulate discocubitus appears in *molokaiensis*, though in much less exaggerated form, but that species has a large fenestra. The fenestra in *orbitalis* and

*perkinsi* of the subgenus *Eremotyloides* is comparable in size and location to that of *Pleuroneurophion*, but there is no trace of thickening or angulation of the discocubitus. The only really anomalous character of this subgenus is the strongly exerted ovipositor (fig. 18). None of the Oriental species referred, because of the angled discocubitus, to *Pleuroneurophion* by Cameron, Szepi-  
geti, and Uchida agrees with the character of the ovipositor.

4. **Enicospilus (Pleuroneurophion) hawaiiensis** (Ashmead), new combination

*Pleuroneurophion hawaiiensis* Ashmead, Proc. U. S. Nat. Mus. 23: 86, 1900; Fauna Hawaiiensis, 1 (3): 342, pl. 9, fig. 1, 1901.

I have examined 48 specimens of both sexes, including the unique type, 10 specimens identified by Ashmead as *Ophion nigricans* Cameron, and 37 received from Mr. Zimmerman, all taken in the neighborhood of Humuula. All specimens are from the island of Hawaii. This fact may account for the very great uniformity in size and very dark color of the specimens.

5. **Enicospilus (Pleuroneurophion) ferrugineus** (Perkins), new combination

*Pleuroneurophion ferrugineus* Perkins, Trans. Ent. Soc. London, 1914: 533, 1915.

There is nothing in the very brief description of this species, except the color, that will distinguish it from *hawaiiensis*, and it may prove to be merely the red phase of that species. It is known only from the island of Maui. Perkins gives no indication of the number, size or sex of the specimens that he had.

Subgenus **Enicospilus** Stephens

6. **Enicospilus (Enicospilus) molokaiensis** Ashmead

*Enicospilus molokaiensis* Ashmead, Fauna Hawaiiensis, 1 (3): 344, 1901; Perkins, Trans. Ent. Soc. London, 1914: 523, 533, 1915.

This and the next two species form a group characterized by the large fenestra (figs. 5-7) occupying nearly half the area and fully three-fourths of the width of the apical portion of the discocubital cell, with the small pyriform or oval proximal sclerome at the lower proximal angle closer, usually much closer, to the discocubitus than to the radius and mostly or entirely proximad of a line perpendicular to the costa through the base of the radial cell; the discocubitus (except in *kaalae*) more or less thickened in the middle and sometimes (*molokaiensis*) angulate or subangulate, but without a ramellus; the second discoidal cell with upper and lower margins subparallel for fully half its length (fig. 19); and the aedeagus

(figs. 5a and 6a) with the apical, bulblike swelling not rising above the general dorsal margin.

The present species, of which I have seen about 70 specimens from Oahu, Hawaii, Kauai, Maui and Molokai, is unusually constant in color, apparently always ferruginous, and exhibits a gradation in size from 10 to 20 mm., with the smaller specimens predominating.

Thickening of radius (fig. 5) occupying about the basal half of abscissa and with a slight upward curvature; sclerome elongate pyriform with a longer or shorter appendix, just proximad of a line perpendicular to costa through base of radial cell; intercubitus one-fourth to one-third as long as second abscissa of cubitus, which is much longer than second recurrent; discocubitus with thickening angulate or subangulate, cubital portion nearly straight; second discoidal cell narrow, upper and lower margins parallel, lower posterior angle approximately a right angle, second recurrent a third or less as long as basal abscissa of subdiscoideus; aedeagus (fig. 5a) very weakly swollen below at apex.

#### 7. *Enicospilus* (*Enicospilus*) *melanochromus* Perkins

*Enicospilus melanochromus* Perkins, Trans. Ent. Soc. London, 1914: 523, 533, 1915.

Of this species, described only in a key to the Hawaiian species, I have seen only two males, both from Mt. Tantalus, Oahu, and both identified by myself by comparison with the description. If these specimens are correctly identified the species can be distinguished from *molokaiensis* by its dark color; by the greater length of the thickened portion of the radius; by the broader and less attenuated sclerome; by the longer intercubitus, which is about half as long as the second recurrent; by the somewhat less distinctly angulate and thickened discocubitus; by the acute lower posterior angle of the second discoidal cell (fig. 6); and by the more strongly swollen apex of the aedeagus (fig. 6a).

#### 8. *Enicospilus* (*Enicospilus*) *kaalae* Ashmead

*Enicospilus kaalae* Ashmead, Fauna Hawaiiensis, 1 (3): 347, 1901; Perkins, Fauna Hawaiiensis, 2 (6): 57, 1910; Trans. Ent. Soc. London, 1914: 524, 533, 1915.

*Enicospilus semirufus* Perkins, Trans. Ent. Soc. London, 1902: 142; Morley, Rev. Ichn. Brit. Mus., 1: 48, 1912.

Of this species I have seen 25 specimens from Oahu, Kauai, and Maui.

In both size and color it is unusually constant, being large and blackish with the abdomen dark red except the petiole and the apex.

Perkins himself synonymized his *semirufus* with *kaalae*.

This species shares with *molokaiensis* and *melanochromus* the large fenestra (fig. 7) with the small, oval, proximal sclerome at the lower proximal corner of the fenestra and basad of a line perpendicular to the costa at the base of the radial cell and the prominent female hypopygium (fig. 19); but differs from both in the evenly curved and unthickened discocubitus and from *molokaiensis* in the form of the aedeagus, in which it resembles *melanochromus*. The sclerome varies slightly in shape and size; the intercubitus is about half as long as the second abscissa of the cubitus; and the second recurrent is about one-third as long as the basal abscissa of the subdiscoideus, these two veins forming a right or slightly obtuse angle (fig. 7).

### 9. *Enicospilus* (*Enicospilus*) *castaneus* Ashmead

*Ophion nigricans* Cameron, Trans. Ent. Soc. London, 1883: 193 (preoccupied by *O. nigricans* Ruthe, Stett. Ent. Zeitg. 20: 378, 1859); Ashmead, Fauna Hawaiiensis, 1(3): 341, 1901.

*Enicospilus castaneus* Ashmead, Fauna Hawaiiensis, 1(3): 349, 1901; Perkins, Trans. Ent. Soc. London, 1914: 528, 534, 1915.

*Ophion nigrutilus* Morley, Rev. Ichn. Brit. Mus., 1: 64, 1912 (substitute name for *O. nigricans* Cameron, preoccupied).

This and the next five species (figs. 8-13) constitute a group characterized as follows: Fenestra rather small, about as broad as long and underlying much less than half length of basal abscissa of radius, proximal sclerome very variable in size and shape, and sometimes absent, but when present always distad of a line perpendicular to costal margin at base of radial cell, rarely (*bellator*, fig. 10) fenestra reduced to a narrow area without sclerome; aedeagus (figs. 8a, 11a) with apex very strongly swollen both below and above. The three species of which I have seen abundant material (*castaneus*, *dispilus* and *lineatus*) are among the most protean in the genus with respect to both size and color of individuals and size and form of the proximal sclerome.

The present species, of which I have seen more than 100 specimens, all from the island of Hawaii, exhibits all gradations in color from entirely ferruginous (*castaneus*) to almost entirely black (*nigrutilus*) and in size from 13 mm. to 23 mm. The sclerome varies from a fairly large, triangular sclerome to total absence.

This and the next two species differ from the other three species of the group in the transversely flat and very densely and coarsely punctate scutellum with unusually high carinae, in the unusually long malar space, in the second discoidal cell being long and narrow with its upper and lower margins parallel in about its apical third

and, in the male, in having the apical tarsal joints (fig. 24) strongly depressed and parallel-sided or even a little broader basad of middle than at apex. The malar space reaches its maximum length in the female of the present species, in which it is combined with unusually shallowly convex eyes to produce a relatively long, narrow head. The antennae in *castaneus*, especially in the female, are unusually short, not reaching the apices of the spread wings. The male is less easily distinguished from that of *dispilus*, but has the malar space definitely longer and always lacks a central sclerome in the fenestra, whereas *dispilus* has at least a trace of one.

#### 10. *Enicospilus* (*Enicospilus*) *dispilus* Perkins

*Enicospilus dispilus* Perkins, Trans. Ent. Soc. London, 1902: 143; 1914: 528, 534, 1915.

*Enicospilus dispilus* var. *pallipes* Perkins, Trans. Ent. Soc. London, 1902: 143.

I have seen 40 specimens from Oahu, Molokai, Maui, Hawaii, and Kauai. In his 1915 paper Perkins does not mention his variety *pallipes* by name, merely stating that "Kauai specimens have the antennae and more or less of the legs pale, yellowish-brown." So far as can be judged from the few specimens from that island that I have seen, this difference seems to hold. All of the specimens from the island of Hawaii that I have seen are largely or entirely ferruginous, only restricted areas of the thorax being somewhat darker in some specimens. This form appears not to have been named, possibly because of confusion with *castaneus*, which was the case with most of the ferruginous specimens in the National Museum, though one was erroneously labeled *waineae* by Ashmead.

The species is easily distinguished from its closest relative (*castaneus*) by the wing characters (fig. 9) of moderately large triangular proximal sclerome and very small almost colorless central sclerome, shorter malar space, and strongly convex eyes.

#### 11. *Enicospilus* (*Enicospilus*) *bellator* Perkins

*Enicospilus bellator* Perkins, Trans. Ent. Soc. London, 1914: 528, 533, 1915.

This species, of which I have seen only four specimens from Hawaii and one from Molokai, is very distinct in the form of the fenestra (fig. 10), which is about twice as long along radius as broad and lacks distinct scleromes, although there is a faint sclerotization along the lower margin. All five specimens are ferruginous, like the type.



12. *Enicospilus lineatus* (Cameron)

*Ophion lineatus* Cameron, Trans. Ent. Soc. London, 1883: 192; Ashmead, Fauna Hawaiiensis 1 (3): 342, 1901.

*Enicospilus mauicola* Ashmead, Fauna Hawaiiensis, 1 (3): 347, 1901; Perkins, Trans. Ent. Soc. London, 1914: 526, 534, 1915. New synonymy.

*Enicospilus henshawii* Ashmead, Fauna Hawaiiensis, 1 (3): 349, 1901.

*Enicospilus dimidiatus* Perkins, Trans. Ent. Soc. London, 1902: 143; Morley, Rev. Ichn. Brit. Mus., 1: 49, 1912. New synonymy.

*Enicospilus capnodes* Perkins, Fauna Hawaiiensis, 2 (6): 679, 1910. New synonymy.

*Henicospilus lineatus* (Cameron) Morley, Rev. Ichn. Brit. Mus., 1: 47, 52, 1912.

*Enicospilus lineatus* (Cameron) Perkins, Trans. Ent. Soc. London, 1914: 526, 1915.

*Enicospilus ashmeadi* Perkins, Trans. Ent. Soc. London, 1914: 527, 1915. New synonymy.

This and the next two species differ as a group from the three preceding species in the form of the second discoidal cell, which is shorter and broader with its upper and lower margins convergent from somewhat basad of the apical third to the apex, and in the more strongly convex scutellum with lower carinae and sparser sculpture.

This abundant species exhibits to the extreme the tendency to break up into color-phases and size-phases. The names *lineatus* and *henshawii* represent the small red form, *dimidiatus* the small dark form, and *mauicola* and *capnodes* the large dark form, while the large red form has not been named; *ashmeadi* represents both of the large forms without the sclerome. In the material that I have examined there is comparatively less intergradation between the forms than in any of the other species. The names applying to the various phases may be of use in certain sorts of studies but I doubt their taxonomic value.

The three valid names in the varietal sense are *lineatus*, *dimidiatus*, and *mauicola*. The others, *capnodes* and *ashmeadi*, are synonymous with *mauicola*. The coarser punctation on the scutellum of *ashmeadi* is merely variation, while the lack of the sclerome, another character of *ashmeadi*, occurs also in both the light and dark specimens in which the scutellum is weakly punctate.

In listing *henshawii* among the synonyms of *lineatus* I am following Perkins, despite the fact that Ashmead himself identified as *henshawii* a specimen of *Abanchogastra hawaiiensis* (Ashmead),

apparently at the time he wrote the paper in which both *hawaiiensis* and *henshawii* were described. It seems possible that this is another instance like that pointed out by Perkins in which Ashmead described from a single specimen his *Pleuroneurophion hawaiiensis* and then identified other specimens of the same species as *Ophion nigricans* Cameron. However, since Perkins has synonymized *henshawii* with *lineatus* after seeing the types of both species it seems best at this time to follow his synonymy.

When present, the proximal sclerome (fig. 11) is distinctly distad of a line perpendicular to the costal margin at the base of the radial cell.

### **Enicospilus funereus** Perkins

*Enicospilus funereus* Perkins, Trans. Ent. Soc. London, 1914: 525, 1915.

Some specimens that I identify as the large dark form of *lineatus* (*mauicola*) agree fairly well with the description of this species, and I suspect that it should be synonymized. The only character that I cannot find in one or another specimen of *lineatus* is the "unusually strongly and densely punctured" second tergite, and I suspect that the punctured appearance is due to the drying of some foreign fluid at the bases of the fine hairs, such as I have observed on a few specimens. In Perkins' key, in which the only description of the species occurs, it is finally separated from *mauicola*, *lineatus*, and *ashmeadi*, all herein treated as synonymous.

### 13. **Enicospilus (Enicospilus) waimeae** Ashmead

*Enicospilus waimeae* Ashmead, Fauna Hawaiiensis, 1(3): 348, 1901; Perkins, Trans. Ent. Soc. London, 1914: 525, 533, 1915.

There is in the United States National Museum one female specimen with the sclerome large as described by Perkins for the type specimen (fig. 12). Like the type it is from Mt. Waimea, Kauai, where it was taken at 4,000 ft. in 1894 by Perkins. Except for the size and form of the sclerome it differs hardly at all from large dark specimens of *lineatus*, and very likely will have to be synonymized with that species; but I have seen no other specimen that approaches it in the size of the sclerome. The sclerome also is somewhat farther basad than in *lineatus*, its proximal margin very slightly basad of a line perpendicular to the costal margin at the base of the radial cell.

### 14. **Enicospilus (Enicospilus) variegatus** Ashmead

*Enicospilus variegatus* Ashmead, Fauna Hawaiiensis, 1(3): 348, 1901; Perkins Trans. Ent. Soc. London, 1914: 525, 533, 1915.

Of this very distinct species there are a female and a male,

the latter identified by Ashmead, in the United States National Museum.

In color the thorax is very similar to that of *nigrolineatus*, yellowish and black, but the black is much more extensive, including the lateral lobes of the mesoscutum, most of the area of the mesopleuron, the metapleuron, and all the propodeum except around the spiracles. Unlike that of *nigrolineatus* the abdomen is dark with the upper edge of the compressed portion yellowish. The fenestra (fig. 13) is essentially like that of *lineatus*, but with the proximal sclerome slightly farther basad and with a faint sclerotization along the distal margin of the fenestra.

#### 15. *Enicospilus* (*Enicospilus*) *nigrolineatus* Ashmead

*Enicospilus nigrolineatus* Ashmead, Fauna Hawaiiensis, 1 (3) : 348, 1901; Perkins, Trans. Ent. Soc. London, 1914: 524, 533, 1915.

One of the most distinct of the Hawaiian species, immediately recognizable by the only slightly variable color pattern of the thorax—yellowish ferruginous with a median black stripe on the mesoscutum and the mesosternum and the propodeum posterior to the carina also black. It is equally distinct in the form of the proximal sclerome (fig. 14), which is elongately triangular with appendix underlying the fenestra to the apex and is situated distinctly apicad of a line perpendicular to the costal margin at the base of the radial cell. The stigma is very narrow and the second discoidal cell narrow with upper and lower margins nearly parallel for about half the length and the second recurrent about a third as long as the basal abscissa of the subdiscoideus.

I have seen 23 specimens from Kauai, Oahu, Maui, Molokai, and Hawaii.

#### 16. *Enicospilus* (*Enicospilus*) *longicornis* Ashmead

*Enicospilus longicornis* Ashmead, Fauna Hawaiiensis, 1 (3) : 350, 1901; Perkins, Trans. Ent. Soc. London, 1914: 524, 533, 1915.

Of this distinct species I have seen only eight specimens, seven from Hawaii and one from Maui.

The fenestra (fig. 15) is rather large; there are two distinct scleromes, the nearly equilaterally triangular proximal and elongately oval central scleromes, the latter parallel to the costal margin, and usually with a faint trace of the distal sclerome. The proximal sclerome is almost entirely basad of a line perpendicular to the costal margin at the base of the radial cell. The stigma is unusually short and broad and the second discoidal cell short with the discocubitus straight basally and convexly curved in about its apical half, the second recurrent nearly half as long as the basal abscissa of the subdiscoideus.

In this species the mandible (fig. 23) bears a conspicuous tuft of long hairs on the outer surface between the middle and the apex. Several of the other species have a few hairs in this position, but in none are they so conspicuous as in *longicornis*.

All the specimens are almost uniformly ferruginous with the head largely or entirely yellowish.

### ***Enicospilus tyrannus* Perkins**

*Enicospilus tyrannus* Perkins, Trans. Ent. Soc. London, 1914: 524, 1915.

In Perkins' key, which furnishes the only description of this species, it is finally separated from *longicornis* only by the character "mesosternum and at least most of the propodeum black," which leads to the suspicion that it is only a somewhat dark form of *longicornis*.

### **17. *Enicospilus pseudonymus* Perkins**

*Enicospilus pseudonymus* Perkins, Trans. Ent. Soc. London, 1914: 529, 1915.

This species, apparently based on a single male, is unknown to me. The lack of a fenestra, the medially elevated mesoscutum (if this is not an abnormality), and the slender basal abscissa of the radius render it anomalous in *Enicospilus*, and I suspect that a new genus should be erected for it.

### ***Abanchogastra hawaiiensis* (Ashmead)**

*Athyreodon hawaiiensis* Ashmead, Fauna Hawaiiensis 1(3): 343, pl. 9, fig. 2, 1901; Perkins, Fauna Hawaiiensis 2(6): 679, 1910.

*Abanchogastra debilis* Perkins, Trans. Ent. Soc. London, 1902: 141. New synonymy.

*Athyreodon debilis* Perkins, Fauna Hawaiiensis 2(6): 680, 1910.

This species exhibits in extreme degree the variation in color characteristic of the Hawaiian *Ophionini*.

Before me are 10 specimens (5 of each sex), a pair of the red phase identified by Perkins as *hawaiiensis*, a pair each of the dark and intermediate phases identified by Perkins as *debilis*, a male of the intermediate phase identified by me as *hawaiiensis*, a red female identified by Ashmead as *Enicospilus henshawii*, and a pair of the red phase identified, probably by D. T. Fullaway, as *hawaiiensis*. In the red phase the body and legs are almost uniformly ferruginous, with the base of the second tergite piceous and the orbits in the female and the face, frons, vertex, and orbits in the male yellow. In the intermediate phase (*hawaiiensis*) the ferruginous is largely

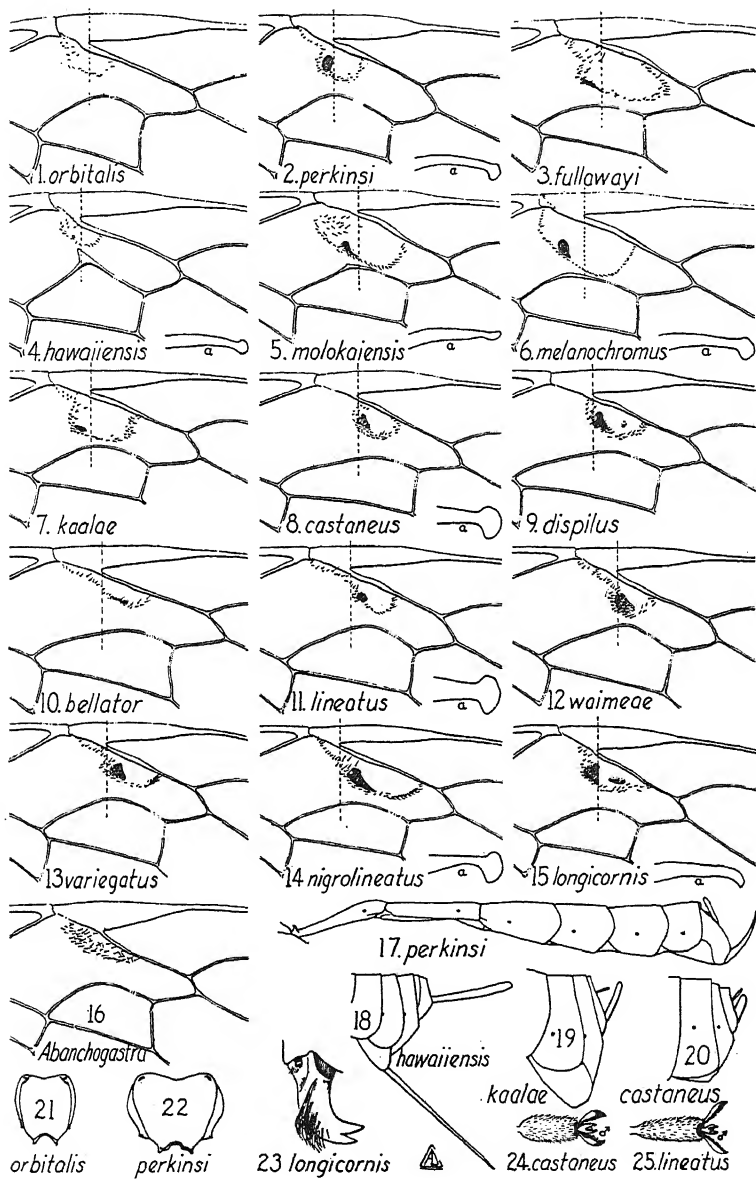
replaced by piceous, the vertex and frons in the female remaining ferruginous and the yellow pattern of the male head remaining the same as in the red phase. In the dark phase (*debilis*), the piceous color is deeper in tone, nearly black on the thorax, and embraces the vertex entirely and the frons medially. It should be noted that the female described by Perkins as *debilis* (hereby designated the lectotype) is of the dark phase whereas the male is of the intermediate phase and almost typical *hawaiiensis*.

The red phase has never been named unless it is indeed *Enicospilus henshawii*. Perkins examined the types of the Ashmead species in the British Museum, and apparently found no reason to doubt

## EXPLANATION OF PLATE II

Portions of forewings, aedeagi, and other details of Hawaiian species of *Enicospilus* and *Abanchogastra*.

- Fig. 1. *Enicospilus orbitalis* (Ashmead). Portion of wing.
- Fig. 2. *Enicospilus perkinsi*, n. sp. Portion of wing and (a) aedeagus.
- Fig. 3. *Enicospilus fullawayi*, n. sp. Portion of wing.
- Fig. 4. *Enicospilus hawaiiensis* (Ashmead). Portion of wing and (a) aedeagus.
- Fig. 5. *Enicospilus molokaiensis* (Ashmead). Portion of wing and (a) aedeagus.
- Fig. 6. *Enicospilus melanochromus* Perkins. Portion of wing and (a) aedeagus.
- Fig. 7. *Enicospilus kaalae* Ashmead. Portion of wing.
- Fig. 8. *Enicospilus castaneus* Ashmead. Portion of wing and (a) aedeagus.
- Fig. 9. *Enicospilus dispilus* Perkins. Portion of wing.
- Fig. 10. *Enicospilus bellator* Perkins. Portion of wing.
- Fig. 11. *Enicospilus lineatus* (Cameron). Portion of wing and (a) aedeagus.
- Fig. 12. *Enicospilus waimeae* Ashmead. Portion of wing.
- Fig. 13. *Enicospilus variegatus* Ashmead. Portion of wing.
- Fig. 14. *Enicospilus nigrolineatus* Ashmead. Portion of wing and (a) aedeagus.
- Fig. 15. *Enicospilus longicornis* Ashmead. Portion of wing and (a) aedeagus.
- Fig. 16. *Abanchogastra hawaiiensis* Ashmead. Portion of wing.
- Fig. 17. *Enicospilus perkinsi*, n. sp. Abdomen of female.
- Fig. 18. *Enicospilus hawaiiensis* (Ashmead). Apex of abdomen of female.
- Fig. 19. *Enicospilus kaalae* Ashmead. Apex of abdomen of female.
- Fig. 20. *Enicospilus castaneus* Ashmead. Apex of abdomen of female.
- Fig. 21. *Enicospilus perkinsi*, n. sp. Propodeum and metapleura.
- Fig. 22. *Enicospilus orbitalis* (Ashmead). Propodeum and metapleura.
- Fig. 23. *Enicospilus longicornis* Ashmead. Mandible.
- Fig. 24. *Enicospilus castaneus* Ashmead. Apical joint of front tarsus of male.
- Fig. 25. *Enicospilus lineatus* (Cameron). Apical joint of front tarsus of male.



the inclusion of *henshawii* in *Enicospilus*, but, except for the lack of the alar sclerome, the specimen labelled *henshawii* by Ashmead agrees better with the description than do specimens identified by Perkins as *lineatus* Cameron (with which Perkins synonymizes *henshawii*), notably in the very strongly arched discocubital vein and the very narrow base of the second discoidal cell. Moreover, among the 26 specimens of *lineatus* that I have seen none is nearly so small as the type of *henshawii*.

I recognize *Abanchogastra* as a genus distinct from *Enicospilus* entirely on characters of venation (fig. 16), the body characters being those of *Enicospilus*. The complete lack of the fenestra, the rather broad stigma with the radius much farther from the base, and the reclivous nervellus broken at or above the middle, features characteristic of *Ophion*, appear sufficient for generic distinction.

## Description of a New Mymarid Egg Parasite Collected at Los Mochis, Sinaloa, Mexico

BY DAVID T. FULLAWAY

Board of Agriculture and Forestry

(Presented at the meeting of November 8, 1943)

### *Anagrus yawi*, n. sp.

Female with the thorax reddish except the mesothoracic scutum which is black. Head and abdomen blackish. Legs and basal three antennal segments yellowish; antennae beyond third segment fuscous. Wings hyaline; slightly dusky at base beneath the short marginal vein. Antennae somewhat longer than the body, scape expanded, fusiform, nearly twice as long as the pedicel, which is obovate; 1st funicle joint slender, a little longer than wide; funicle joints 2 to 6 subequal in length and about three times as long as wide, successively increasing very slightly in length as well as width; club stout, nearly three times as long as wide, nearly as long as funicle joints 5 and 6 combined and twice as wide. Forewing extending more than a third its length beyond the apex of the abdomen, more than six times as long as its greatest width, not including marginal fringe, which is as long as, or (on posterior margin near apex) longer than greatest width; discal cilia rather sparse and generally confined to three longitudinal lines of short hairs, two in the anterior half of the wing (one of these extended by five hairs almost to base of marginal vein; outwardly beyond widest part of wing spread out into additional but somewhat irregular lines) and one in the posterior half along the margin. Hind wings narrow with fringe on anterior margin less than half as long as that on posterior margin, and no discal ciliation except along the margins. Tarsal joints sub-equal. Abdomen about as long as the thorax, ovate to securiform, the hypopygium extending a little beyond the apex of last tergite.

Male agreeing with the female except in the secondary sexual characters about as follows: Antennae nearly twice as long as the body, very slender, 13-jointed, scape short and thick, approximately twice as long as wide, pedicel shorter and narrower, about three times as long as wide, funicle joints sub-equal and each about four times as long as wide. Abdomen hardly as long as thorax.

Length about 0.5 mm.

Described from numerous specimens prepared and mounted on slides in balsam and collected at Los Mochis, Sinaloa, Mexico, where they were found emerging from the eggs of the mirid bug *Pycnoderes quadrimaculatus* Guerin.

Named for Fred L. Yaw, of Los Mochis, Sinaloa, Mexico, whose kind assistance contributed to the discovery of this valuable parasite, and to its eventual introduction and establishment in Hawaii.

Types in the collection of the Hawaiian Entomological Society, Honolulu.





## Insects of Vegetable Crops in Hawaii Today

BY F. G. HOLDAWAY

Entomologist, Hawaii Agricultural Experiment Station

(Presidential address, delivered December 13, 1943)

Two years ago, almost to the day, Hawaii was attacked by Japan and the United States became actively involved in the war. The events which followed have forced on Hawaii the need for producing more of its food than it produced formerly—a necessity which has been accentuated by the increase in population through the influx of defense workers and service personnel. Because of these events, and because I have been actively engaged in advancing our knowledge of insects of food crops and their control, and in disseminating that knowledge to the public, it is perhaps natural that I should select for review “The present situation regarding insects of vegetable crops in Hawaii.”

The maritime strike of 1936 demonstrated the undue extent to which Hawaii was dependent on outside sources of foods. As a result the Hawaii Experiment Station at the University made a move to re-establish the positions of Plant Pathologist and Entomologist, positions which had been allowed to lapse for many years. In 1937 I arrived in Honolulu to re-establish an Entomology Department in the Station. The Station had been without an entomologist for twenty-two years. I was charged especially with carrying on research on the insects of vegetable crops.

In the twenty-two years which had passed since Mr. Fullaway left the Experiment Station to accept a position with the Board of Agriculture and Forestry and the position of entomologist lapsed, there had been many changes. Agriculture had changed. Technical work on sugar cane was already being handled by a separate experiment station. The needs of the pineapple industry were being handled by a separate experiment station with its own entomology department. Many of the crops that the Territory had been interested in during the first fifteen years of the present century had dropped out of the agricultural picture; others were entering it. New insect problems were arising.

The first step of the new Entomology Department was, then, to determine what insect problems it would be called on to handle. True, I had been provided with a list of some twenty odd important insect problems needing attention; and the entomologists of the respective organizations of the Territory had been making observa-

tions of considerable value over the years. But this information was inadequate. Observations soon revealed that many important problems were not on the list I had been given; other observations revealed that several insects we encountered had not even been recorded in the Territory; other insects had been recorded but were not regarded as economically important.

I shall, therefore, discuss briefly some of the aspects of this changing scene, especially as it concerns the insects, and, in particular, the new immigrants and those insects formerly of little consequence but which have become important.

## The Changing Scene

### *Changing Agriculture*

While observations made prior to the beginning of the present century have an important bearing on the field of economic entomology, applied entomology in Hawaii may be said to date from the appointment on July 1, 1902 of D. L. Van Dine to the position of entomologist in the Hawaii Agricultural Experiment Station, which at that time was supported wholly by Federal funds.

On May 18, 1903 the Division of Entomology of the newly created Board of Commissioners of Agriculture and Forestry was organized.

In August 1904 the Division of Entomology of the Experiment Station of the Hawaiian Sugar Planters' Association was created.

On December 15, 1904 a meeting was held to consider the advisability of forming a Hawaiian Entomological Society and on January 26, 1905 the new society held its first meeting. (It is of interest to note in passing that Mr. O. H. Swezey who is still one of the most active members of the Society and also the Editor of the Proceedings was present at those first two meetings and was elected a member of the first executive committee. He is the only one of the original members who is still active and regularly attends the Society's meetings.)

Thus four important entomological events took place during the four years 1902-1905 inclusive.

An examination of Van Dine's early reports gives an interesting picture of the agriculture of the day and the problems the entomologist was called on to handle. His partial lists of crops in the reports of the entomologist for 1904 (32), 1905 (33), 1906 (34), and 1907 (35) were revised and summarized in his report for 1908 (36) as "A revised list of the injurious insects of Hawaii." His list included the following twenty-six crops: Sugar, rice, coffee, taro, sisal, tobacco, cotton, cassava, sweet potato, corn, cabbage, melon, pineapple, citrus, mango, banana, avocado, fig, grape, apple, peach, guava, mulberry, strawberry, sour sop, coconut, and ornamental

and forest trees. It includes many field crops, some fruit trees and some small fruits, but only three vegetable crops. If one includes corn, which was in any case no doubt field corn, there are four vegetables. In the partial list for 1904 (32) six vegetable crops were mentioned—cucurbits, bean, tomato, corn, cabbage, and potato, and seven vegetable insects were cited.

In the report of the entomologist for 1913 by D. T. Fullaway (2) who had succeeded Van Dine in 1909, the following fourteen particular vegetable crops were mentioned: cabbage, turnip, radish, celery, parsley, carrot, potato, tomato, eggplant, cucumber, pumpkin, squash, spinach, and onion. The insects which attacked them were also given. It would appear from this longer list that vegetables were receiving greater attention. Moreover since many of the larger field crops and some of the fruits mentioned in Van Dine's earlier lists received little attention, it would appear that they were passing from the agricultural picture.

By 1915 Mr. Fullaway had resigned to accept his position with the Board of Agriculture and Forestry, and, apart from the observations and other intermittent work carried on by the entomologists of the various institutions of the Territory, research on vegetable insects as the special responsibility of an entomologist or a group of entomologists ceased until 1937 when the entomology department was re-established in the Hawaii Agricultural Experiment Station.

In the years just prior to 1937 interest in vegetable production had begun to increase. Head cabbage, Chinese cabbage, and other related crops were grown to an increasing extent, and for considerable periods supplied completely the needs of the Territory for these crops. Green bean production increased so that just before the war the Territory was producing all the beans it required. Interest in tomato production was increasing. There was also renewed interest in Irish potato production.

During the defense emergency, 1939-41, interest in sweet-potato and lima bean increased, and, following our entry into the war there was a further increase in interest in Irish potato. Through the stimulus to Victory gardens, interest in the so-called "small crops" increased.

Thus even during the past few years the agricultural picture has changed and is still changing. It is necessary to be aware of these developments since they often involve changes in the relative importance of insects too.

#### *Vegetable insects new to Hawaii*

During the years just prior to 1937 the following eight vegetable insects had been found in Hawaii for the first time:

Bean-pod borer, *Maruca testulalis* (Geyer) in 1922 by  
Swezey .....[Swezey (28)]

- Tomato bug *Cyrtopeltis varians* (Distant) in 1924 by Swezey ..... [Swezey (29)]
- Tomato pinworm, *Keiferia lycopersicella* (Busck) in 1925 by Swezey ..... [Swezey (31)]
- Vegetable weevil, *Listroderes obliquus* Klug in 1926 by Swezey ..... [Swezey (30)]
- Bean capsid, *Pycnoderes quadrimaculatus* Guerin-Meneville in 1929 by Illingworth ..... [Illingworth (20)]
- Pepper weevil, *Anthonomus eugenii* Cano in 1933 by Fullaway ..... [Fullaway (3)]
- Datura beetle, *Lema trilineata californica* Schaeffer in 1933 (?) by Krauss ..... [Krauss (21)]
- Chrysanthemum thrips, *Thrips nigropilosus* Uzel in 1935 by Sakimura ..... [Sakimura (26)]
- Since 1937 the following thirteen additional insects (and mites) have been found:
- Aphis rumicis* Linnaeus in 1938 by Lucas ..... [Look and McAfee (23)]
- Cavariella capreae* (Fabricius) in 1939 by Marvin ..... [Look and McAfee (23)]
- Onion moth, *Acrolepia assectella* Zeller in 1939 by Holdaway (collected by Furuya) ..... [Holdaway (14)]
- Turnip aphid, *Rhopalosiphum pseudobrassicae* (Davis) in 1939 by Look ..... [Holdaway, Look and Lucas (19)]
- Cabbage looper, *Autographa brassicae* (Riley) in 1939 by Lucas (collected by Akana) ..... [Holdaway, Look and Lucas (19)]
- Onion aphid, *Micromyzus formosanus* (Takahashi) in 1939 by Look ..... [Holdaway, Look and Lucas (19)]
- Dendrothripoides ipomeae* Bagnall in 1940 by Bianchi ..... [Bianchi (1)]
- Celery aphid, *Brachycolus heraclei* Takahashi in 1940 by Holdaway ..... [Look and McAfee (23)]
- Myzus convolvuli* (Kaltenbach) in 1941 by Lucas ..... [Look and McAfee (23)]
- Tomato russet mite, *Phyllocoptes destructor* Keifer in 1942 by Holdaway ..... [Holdaway (13)]
- Rusty-banded aphid, *Aphis ferruginea-striata* Essig in 1942 by Zimmerman ..... [Zimmerman (37)]
- Frankliniella* sp. in 1942 by Nishida ..... [Nishida (25)]
- Bean thrips, *Hercothrips fasciatus* (Pergande) in 1943 by Krauss ..... [Krauss (22)]<sup>1</sup>

Thus a number of new economic insects had entered the scene just prior to our embarking on a detailed study of vegetable insects, while several more have been recorded since we began our work.

<sup>1</sup> In a subsequent survey Krauss was unable to recover this insect (26).

The situation has led me to inquire "What has been happening over a longer period of time?" It has been found that since 1880 new economic insect immigrants have continually been recorded in Hawaii. Prior to 1937 the greatest number of new records of vegetable insects per five-year period, eleven species, occurred during 1905-1909 inclusive. This was the period immediately following the important developments in entomology which have already been mentioned. All these developments resulted in an increase in the number of entomological observers in the Territory and an increase in interest in matters entomological.

From 1910 onward there continued to be new records of insect immigrants but the rate of discovery fell off considerably. There was only one new record for the five-year period 1910-1914 inclusive. In the period 1915-1919 there were three new records and for the period 1920-1924 three more. One is led to the conclusion that either the new vegetable insect immigrants had to a large extent been discovered or new immigrants were not entering the Territory as frequently. Possibly both factors were operating.

What then is the explanation for the increase in records over recent years? No doubt the increased attention to insects of vegetables in the Hawaii Experiment Station has played an important part for the majority of the records are by the new group of workers. But not all the records have been made by this new group. I have concluded that the new records are in part due to the increase in vegetable importations over the past fifteen years. If this conclusion is correct, and it is supported by Mr. Fullaway, who has had more opportunity for observing the importations of vegetables than any other entomologist in the Territory, what of the future? Must we expect even more introductions? Can the quarantine service succeed in blocking them?

#### *New problems from insects already present in the Territory*

I have mentioned the new immigrant species of vegetable insects which have entered the Territory in recent years. Some of these have already made their presence felt in the crop production picture. Cabbage looper is capable of considerable injury to head cabbage at low elevations. Onion aphid, while, in general, not abundant, is also capable of serious injury when infestations are allowed to go unchecked. Turnip aphid, also, has shown, by the injury it has caused to some crops, that it is a potentially important insect. Celery aphid is the most important insect of celery today. It is capable of devastating injury if uncontrolled. We have recorded it on Oahu, Maui, and Hawaii. Tomato russet mite, which is now fairly widespread on Oahu and present also on Maui and Kauai, is capable of

complete destruction of plants if it is not controlled. All these insects must be reckoned with in vegetable production in the future.

There are other insects, however, that have been present in the Territory some time, but which have become more important through changes in the agriculture of the Territory or for other reasons not yet fully understood. Greenhouse white fly, *Trialeurodes vaporariorum* (Westw.) present in the Territory for over half a century, has become a limiting factor to green bean production in the Waianae section of Oahu—a section which formerly produced up to 58 per cent of the green beans grown on this island. (10) (12) (15). Fire ant, *Solenopsis geminata rufa* (Jerdon), which formerly was an occasional pest of the roots and stems of tomato plants, cucumber plants, and eggplants, (18) has become more important because of the increased production of these crops at the low elevations where this ant is common. Loss of crops of carrot, beet, and chard in the cotyledon stage has been shown to be due to garden flea-hopper, *Leucopoeila albofasciata* Reut. (11). This is another problem whose severity is increased by the increasing vegetable production. Prior to 1941 tomato bug was not a particularly important insect of tomato because conditions favorable to the bug were unfavorable to tomato production with the varieties that were then available. In 1941 Dr. Frazier found that "Bounty," one of his new introductions, was particularly suitable for growth under our low elevation, high temperature conditions. These were the conditions under which tomato production was difficult with the varieties formerly available. Following the introduction of "Bounty," commercial tomato production in the Territory during the six-month period of summer months, June-November, inclusive, has increased 79 per cent in two years. On Oahu, where the summer increase is most marked, production of tomatoes has advanced 264 per cent. Through this change in production of tomatoes during summer at low elevations tomato bug has now become an important factor in the growing of tomatoes (12).

### The Insects of Vegetables Today

As a result of the new insect immigrants and the increased importance of many other species, the insects of vegetables today are different from those recorded at any other time in the history of the Territory.

In an insect control program it is necessary first to determine which species of insects are responsible for injury to the respective vegetables and when, where, or under what conditions injury occurs. Hawaii has no winter to speak of. Thus the low temperatures so characteristic of continental areas are not available to reduce the abundance of the crop insects. Nevertheless there are marked relationships between certain insects and climatological

zones or physiographic areas. Some are insects of low elevation; some are insects of high elevation; some are insects of the summer; some are most abundant in regions of intermediate rainfall; some are apparently little affected by climatic conditions or physiography but are affected more by abundance of host crops and especially by the sequence of crop hosts than by any other factor. Further it is necessary to determine the *group* of insects which occurs on each crop and which of them are of major importance. When the major problems have been determined, experimental work on the control of the major insects can be devised with due regard for the possible presence of other insects or diseases.

A considerable amount of knowledge has been built up on the insects of the respective vegetables. While much more work remains to be done, and while further observations will undoubtedly result in some modification of ideas held at the present time, sufficient information has been secured for the practical needs of the moment.

In the accompanying table I have listed the insects of 30 vegetables. They are grouped as major insects, submajor insects, occasional pests, and minor insects.

Major insects are those which cause major economic loss of the crop attacked unless they are controlled. They are, in general, widespread in their distribution. They are not necessarily present on the crop at all times and in all places; some are restricted as to vegetation zone and season.

Submajor insects are those insects which may cause major economic loss at times, but less severely, less often, or to a less widespread extent than the major insects.

Occasional pests are those minor insects which occasionally are present in sufficient numbers to cause marked injury.

Minor insects are those which may feed freely on or reproduce on the host crop but which do not cause marked injury to the crop.

In the observations which have been made to date some crops have received more attention than others and a more complete picture of the insects of such crops has thus been secured. Although the amount of time given to the respective crop has varied, it is probable that further observations will not lead to any marked changes in designation of the major and the submajor insects.

You will observe from the table that there is a comparatively small number of major insects for each crop—sometimes none—but a larger number of the group I have designated as “submajor.” There is a relatively large number of the minor insects which occasionally are present in numbers sufficiently large to cause injury. The list of insects designated as minor is approximately the same size as that of the occasional pests. From the practical standpoint the major and submajor insects are of most consequence. Many of these, however, are not present for considerable periods.



Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.<sup>1</sup>

Crop	MAJOR INSECTS <sup>1</sup>	SUBMAJOR PESTS <sup>1</sup>	OCCASIONAL PESTS <sup>1</sup>	MINOR INSECTS <sup>1</sup>
Bean (green)	<i>Adoretus sinicus</i> <i>Aphis medicaginis</i> <i>Trialeurodes vaporariorum</i> † <i>Empoasca solana</i> *	<i>Pycnoderes quadrimaculatus</i> * <i>Hemitarsonemus latus</i> * <i>Tetranychus</i> sp.* <i>Plusia chalcites</i>	<i>Heliothis armigera</i> <i>Veronicaella leydigi</i> <i>Liriomyza pusilla</i> <i>Frankliniella</i> sp. <i>Stictoccephala festina</i> <i>Solenopsis geminata</i> * <i>Dacus cucurbitae</i>	<i>Aphis gossypii</i> <i>Cosmolyce botica</i> <i>Phenacoccus gossypii</i> <i>Atractomorpha ambigua</i> <i>Cyrtopeltis varians</i> <i>Myzus persicae</i>
Bean (lima)	<i>Mariuca testulalis</i> <i>Aphis medicaginis</i>	<i>Pycnoderes quadrimaculatus</i> * <i>Tetranychid</i> sp.*	<i>Stictoccephala festina</i> <i>Frankliniella</i> sp.* <i>Plusia chalcites</i>	<i>Empoasca solana</i> * <i>Aphis rumicis</i>
Beet	<i>Hymenita recurvalis</i> * <i>Hemitarsonemus latus</i> *	<i>Leucopocella albofasciata</i> § <i>Empoasca solana</i> * <i>Laphygma erigina</i>	<i>Nysius nigriscutellatus</i> *	<i>Myzus persicae</i> <i>Plusia chalcites</i>
Broccoli	<i>Pieris rapae</i> <i>Helula undalis</i> *	<i>Adoretus sinicus</i> <i>Autographa brassicae</i> <i>Agrotis ypsilon</i> <i>Brevicoryne brassicae</i> <i>Myzus persicae</i> <i>Murgantia histrionica</i> <i>Eulota similaris</i>    <i>Veronicaella leydigi</i> ¶	<i>Laphygma erigina</i> <i>Thrips tabaci</i> <i>Plutella maculipennis</i> *	<i>Laphygma erigina</i> <i>Liriomyza pusilla</i>
Cabbage (Chinese)	<i>Helula undalis</i> *	<i>Adoretus sinicus</i> <i>Eulota similaris</i>    <i>Pieris rapae</i> <i>Peridroma margaritosa</i> <i>Rhopalosiphum pseudobrassicac</i> <i>Myzus persicae</i>	<i>Liriomyza pusilla</i> <i>Nysius nemoricagust</i> † (Hawaii) <i>Listroderes obliquus</i> † (Maui, Hawaii) <i>Murgantia histrionica</i>	<i>Brevicoryne brassicae</i> <i>Laphygma erigina</i>

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.<sup>1</sup>—Continued.

Crop	MAJOR INSECTS <sup>1</sup>	SUBMAJOR PESTS <sup>1</sup>	OCCASIONAL PESTS <sup>1</sup>	MINOR INSECTS <sup>1</sup>
Cabbage (head)	<i>Pieris rapae</i> <i>Heliothis virescens</i> *	<i>Autographa brassicae</i> <i>Agrotis ypsilon</i> <i>Eutota similalis</i> † <i>Veronica leydigi</i> ‡ <i>Brevicoryne brassicae</i> <i>Myzus persicae</i> <i>Murgantia histrionica</i> <i>Peridroma margaritosa</i>	<i>Atractomorpha ambigua</i> <i>Plutella maculipennis</i> * <i>Listroderes obliquus</i> † (Maui, Hawaii) <i>Laphygma exigua</i> <i>Thrips tabaci</i> <i>Heliothis virescens</i> <i>Plusia chalcites</i>	<i>Liriomyza pusilla</i> Earth worm sp.
Carrot		<i>Agrotis ypsilon</i> <i>Listroderes obliquus</i> † (Hawaii) <i>Brevicoryne brassicae</i> <i>Leucopocilla albofasciata</i> §	<i>Tetranychid</i> sp. <i>Pseudococcus brevipes</i> <i>Aphis ferruginea-striata</i> <i>Brachycolus heraclei</i>	<i>Laphygma exigua</i> <i>Atractomorpha ambigua</i>
Celery	<i>Brachycolus heraclei</i>	<i>Plusia chalcites</i>	<i>Pseudococcus brevipes</i> <i>Tetranychid</i> sp. <i>Coccus viridis</i> <i>Veronica leydigi</i> <i>Thrips tabaci</i>	<i>Aphis gossypii</i> <i>Liriomyza pusilla</i> <i>Agromyza virescens</i>
Chard	<i>Hymenidia recurvalis</i> * <i>Hemitarsonemus latus</i> *			<i>Empoasca solana</i> * <i>Nysius nigricutellatus</i>
Chinese spinach		<i>Hymenidia recurvalis</i> *	<i>Agrotis ypsilon</i> <i>Empoasca solana</i> * <i>Leucopocilla albofasciata</i>	<i>Myzus persicae</i> <i>Nysius nigricutellatus</i> <i>Laphygma exigua</i>

<sup>1</sup> Including Acarina, Mollusca and Annelata.

\* At low elevations.

† At onset of dry season.

‡ During wet season.

§ At higher elevations.

† In Waianae and Lualualei, Oahu and certain other isolated places.

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.<sup>1</sup>—Continued.

Crop	MAJOR INSECTS <sup>1</sup>	SUBMAJOR PESTS <sup>1</sup>	OCCASIONAL PESTS <sup>1</sup>	MINOR INSECTS <sup>1</sup>
Corn (sweet)	<i>Heliothis armigera</i> <i>Perezgrinus maidis</i> * <i>Aphis maidis</i>	<i>Adoretus sinicus</i> <i>Laphygma eximpta</i> <i>Agrotis ypsilon</i>		<i>Amorbia emigratella</i> <i>Atractomorpha ambigua</i> <i>Carpophilus hemipterus</i> <i>Carpophilus humeralis</i> <i>Plusia chalcites</i>
Cowpea	<i>Empoasca solana</i> *	<i>Aphis medicuginis</i>	<i>Maruca testulalis</i> <i>Hemitarsonemus latus</i> *	<i>Heliothis armigera</i>
Cucumber	<i>Dacus cucurbitae</i> <i>Aphis gossypii</i>	<i>Aponecyna peritigera</i> <i>Empoasca solana</i> * <i>Pycnoderes quadrimaculatus</i> *	<i>Solenopsis geminata</i> * <i>Nysius nemoreuagust</i> (Hawaii) <i>Colombola</i> sp. (Hawaii)	<i>Thrips tabaci</i>
Daikon	<i>Helveta undalis</i> *	<i>Rhopalosiphum pseudobrassicae</i>	<i>Liriomyza pusilla</i> <i>Murgantia histrionica</i> <i>Listroderes obliquus</i> <i>Pseudococcus brevipes</i>	<i>Myzus persicae</i>
Eggplant	<i>Adoretus sinicus</i> * <i>Tetranychid</i> sp.* <i>Hemitarsonemus latus</i> *	<i>Epitrix parvula</i> * <i>Aphis gossypii</i> <i>Saissetia nigra</i> <i>Anthonomus eugenii</i> <i>Contarinia lycopersici</i> * <i>Frankliniella</i> sp.*	<i>Thecla eciton</i> <i>Myzus persicae</i> <i>Agrotis ypsilon</i> <i>Gnathoschema operculella</i> <i>Solenopsis geminata</i> * <i>Icerya purchasi</i> <i>Phenacoccus gossypii</i> <i>Lema trilineata californica</i> <i>Trialeurodes vaporariorum</i>	<i>Heliothis armigera</i> <i>Amorbia emigratella</i> <i>Plusia chalcites</i> <i>Empoasca solana</i> <i>Macrosiphum solanifolii</i> <i>Atractomorpha ambigua</i>
Lettuce		<i>Plusia chalcites</i> <i>Empoasca solana</i> * <i>Thrips tabaci</i> * <i>Thrips nigropilosus</i>	<i>Pycnoderes quadrimaculatus</i> * <i>Listroderes obliquus</i> (Hawaii) <i>Heliothis armigera</i>	<i>Liriomyza pusilla</i> <i>Autographa brassicae</i> <i>Dendrothripoides ipomeae</i> <i>Laphygma exigua</i>

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.<sup>1</sup>—Continued.

Crop	MAJOR INSECTS <sup>1</sup>	SUBMAJOR PESTS <sup>1</sup>	OCCASIONAL PESTS <sup>1</sup>	MINOR INSECTS <sup>1</sup>
Lettuce (Cont'd)		<i>Agrotis ypsilon</i> <i>Eutota similis</i> § <i>Veronicella leydigi</i> ¶	<i>Trialeurodes vaporariorum</i>	<i>Macrosiphum solanifolii</i>
Mustard	<i>Haltella undalis</i> *	<i>Mycus persicae</i>	<i>Pycnoderes quadrimaculatus</i> * <i>Hemitarsonemus latus</i> * <i>Liriomyza pusilla</i>	<i>Atractomorpha ambigua</i>
New Zealand spinach		<i>Hymenia recurvatis</i> *	Tetranychid sp.*	
Okra	<i>Aphis gossypii</i>	<i>Adoretus sinicus</i>	Tetranychid sp.	<i>Empoasca solana</i> * <i>Saissetia nigra</i> <i>Pycnoderes quadrimaculatus</i> * <i>Frankliniella</i> sp.*
Onion		<i>Laphygma exigua</i> <i>Thrips tabaci</i> <i>Micromyzus formosanus</i>	<i>Taeniothrips alliorum</i>	<i>Acrolepia assectella</i> <i>Atractomorpha ambigua</i>
Parsley			<i>Plusia chalcites</i> Tetranychid sp.* <i>Brachycolus heraclei</i>	<i>Atractomorpha ambigua</i>
Pepper	<i>Anthonomus eugenii</i> <i>Hemitarsonemus latus</i> *	<i>Laphygma exigua</i> <i>Aphis gossypii</i> <i>Contarinia lycopersici</i> * <i>Frankliniella</i> sp.* <i>Mycus persicae</i>	<i>Ceratitis capitata</i>	<i>Heliothis armigera</i> <i>Thecla echni</i> <i>Phenacoccus gossypii</i> <i>Saissetia nigra</i>

<sup>1</sup> Including Acarina, Mollusca and Annulata.

\* At low elevations.

§ At onset of dry season.

¶ During wet season.

† At higher elevations.

‡ In Waianae and Lualualei, Oahu and certain other isolated places.

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii. 1.—Continued.

Crop	MAJOR INSECTS <sup>2</sup>	SUBMAJOR PESTS <sup>1</sup>	OCCASIONAL PESTS <sup>1</sup>	MINOR INSECTS <sup>1</sup>
Potato	<i>Gnorimoschema operculella</i> *	<i>Plusia chalcites</i> <i>Laphygma exigua</i> <i>Macrosiphum solanifolii</i> <i>Agrotis ypsilon</i>	<i>Aphis gossypii</i> <i>Myzus persicae</i> <i>Empoasca solana</i> * <i>Hemitarsonemus latus</i> * <i>Nysius migriscutellatus</i> <i>Nysius nemorevagus</i> † <i>Peridroma margaritosa</i> <i>Epitrix pumila</i> <i>Listroderes obliquus</i> † (Maui, Hawaii)	<i>Thrips tabaci</i> <i>Atractomorpha ambigua</i> <i>Heliothis armigera</i> <i>Laphygma eximia</i> * <i>Aleyrodis</i> sp. <i>Cyrtopeltis varians</i> <i>Pseudococcus longispinus</i> <i>Leana trilineata californica</i> <i>Thecla echion</i>
Radish	<i>Hellula undalis</i> *		<i>Listroderes obliquus</i> † (Maui, Hawaii) <i>Rhopalosiphum pseudobrassicae</i>	
Soybean		<i>Adoretus sinicus</i>	<i>Hemitarsonemus latus</i> * <i>Laphygma exigua</i>	<i>Icerya purchasi</i> <i>Aphis medicaginis</i>
Spinach		<i>Hymenia recurvalis</i>	<i>Plusia chalcites</i> <i>Empoasca solana</i> * <i>Hemitarsonemus latus</i> *	<i>Myzus persicae</i> <i>Aphis gossypii</i>
Sweetpotato	<i>Bedellia orchitella</i> <i>Omphisa anastomosalis</i> <i>Euscaphes postfasciatus</i>	<i>Cylas formicarius</i> <i>Herse cingulata</i>	<i>Adoretus sinicus</i> <i>Pycnoderes quadrimaculatus</i> * <i>Plusia chalcites</i>	<i>Laphygma exigua</i> <i>Dendrothripoides ipomeae</i> <i>Aloha ipomeae</i> <i>Atractomorpha ambigua</i> <i>Aphis gossypii</i> <i>Tetranychid</i> sp.* <i>Hemitarsonemus latus</i> * <i>Empoasca solana</i> * <i>Aphis medicaginis</i>

Table 1. The Major Insects, Submajor Insects, Occasional Pests, and Minor Insects of 30 Vegetables in Hawaii.<sup>1</sup>—Continued.

Crop	MAJOR INSECTS <sup>1</sup>	SUBMAJOR PESTS <sup>1</sup>	OCCASIONAL PESTS <sup>1</sup>	MAJOR INSECTS <sup>1</sup>
Sweetpotato (Cont'd)				<i>Macrosiphum solanifolii</i> <i>Myzus persicae</i>
Tahitian spinach			<i>Pontania nigronervosa</i> <i>Aphis gossypii</i>	Tetranychid sp. <i>Rhopalosiphum nymphaeae</i>
Tomato	<i>Heliothis armigera</i> <i>Dacus cucurbitae</i> <i>Cyrtopeltis varians</i> * <i>Phyllocolpa destructor</i> *	<i>Keiferia lycopersicella</i> * <i>Epitrix borealis</i> * <i>Macrosiphum solanifolii</i> <i>Aphis gossypii</i> <i>Hemitarsonemus latus</i> * <i>Contarinia lycopersici</i> * <i>Frankliniella</i> sp.*	<i>Gnorimoschema operculella</i> <i>Laphygma eximpta</i> <i>Trialeurodes vaporariorum</i> † <i>Solenopsis geminata</i> * <i>Plusia chalcites</i> <i>Agrotis ypsilon</i> <i>Tenebrionid</i> sp.	<i>Thrips tabaci</i> (important as a vector of spotted wilt) <i>Atractomorpha ambigua</i>
Turnip	<i>Helula undalis</i> *		<i>Listroderes obliquus</i> † (Maui, Hawaii) <i>Agrotis ypsilon</i> <i>Myzus persicae</i>	

<sup>1</sup> Including Acarina, Mollusca and Annelata.

\* At low elevations.

§ At onset of dry season.

¶ During wet season.

† At higher elevations.

‡ In Waianae and Lualualei, Oahu and certain other isolated places.

## The Control of Major Insects of Vegetable Crops in Hawaii

I have indicated earlier that for 22 years it was no one's special responsibility to work on vegetable insects. It was not surprising, therefore, to find from the surveys which I made during 1938 and 1939 of the literature and of conditions in the field that there was very little organized knowledge available on the vegetable insects, while the control of the insects was almost non-existent. Some attention had been given to the biological control of a few of the vegetable insects by entomologists of the Board of Agriculture and Forestry. But this line of attack, which has been so successful against several of the important agricultural insects of Hawaii, had not received the attention it deserves. Materials for chemical control were little known and only a few were available.

Nicotine sulphate, Paris green, arsenate of lead and sulphur were available in small quantities. Nicotine sulphate was not used to any great extent against insects for which it is suitable. Paris green was used mainly for cutworm baits, and occasionally as a spray on Irish potatoes. Arsenate of lead was used very little. Use of sulphur was restricted almost exclusively to the most obvious red spider infestations; it was not used as commonly or as freely as it could have been.

Pyrethrum was available in comparatively small quantities as a Japanese product known as "Imazu." The pyrethrin content of this product was not known. Moreover it was commonly used as an all-purpose spray, often wastefully and with little result. Indeed there was little likelihood of its being successful against many of the problems for which it was used. Another pyrethrum product, "Pyrocide," had just been introduced to the Territory in small quantities.

No cryolite was available. There was no calcium arsenate and no raw rotenone powder. A small quantity of a rotenone powder had been on the market at one time a few years previously but supplies had not been continued. A commercial preparation of rotenone and pyrethrum, "Foliafume", had just appeared on the local market. While it was an effective preparation for certain problems, and a very suitable preparation for small home gardens, it was comparatively expensive for use in commercial production. Moreover, as with "Imazu," it was often used as an all-purpose spray against insects not likely to be controlled effectively by it. Most of the insecticides available were small packaged preparations put out by one or two west coast insecticide firms. Many of these prepared products were mixtures put up for certain combinations of problems present in various sections of the mainland and not necessarily of any particular use for Hawaii.

The lack of insecticides and the small use to which those available were put were no doubt due to the fact that until our own

experimental work began in 1938 there was no satisfactory basis for recommendations, importation, distribution and use of the respective insecticides.

The situation is well illustrated by the following facts. In 1913, Fullaway (2) wrote regarding cabbage webworm, even then considered to be a serious pest of cabbages and related plants, "Little can be suggested in the way of remedies as all the insecticides experimented with by Marsh failed to give appreciable results." In 1938, twenty-five years later, there were still no remedies available; moreover the vegetable growers still referred to the occurrence of cabbage webworm as due to the presence of a "sick wind" regarding which nothing could be done!

Today the ten or twelve crops which are severely attacked by cabbage webworm can be grown and are being grown satisfactorily without fear of the "sick wind," since we have demonstrated experimentally that rotenone dust and cryolite dust will control cabbage webworm satisfactorily.

In the table which I have just presented I have given part of the information necessary to a satisfactory program of research on control. Until the major and submajor insects have been determined and the relative importance of each insect on each crop has been evaluated, a program of research is likely to result in considerable loss of time and a good deal of misdirected effort. From the evidence on major and submajor insects it is possible to determine which are the particular insects calling for special experimentation and which are the "Key" problems on each crop. Moreover in planning a control program it is necessary to know something of the disease problems likely to be present on the respective crops, and whether any of them are also "Key" problems which must be reckoned with in the insect control program. Further it is also necessary to know the relative importance of "Key" insect problems and "Key" disease problems.

A few particular examples will make my point clearer.

Head cabbage has no regular major disease problems comparable in power to destroy a crop with the insect problems.<sup>1</sup> Thus experimentation could proceed on the insect problems with little or no thought to the possible disease problems. Moreover it has been determined that the key problems on this crop are cabbage webworm and cabbage butterfly. Further, the relative importance of these two key problems will depend on the locality and the season; at elevations below 1,000 feet, and especially in the summer months, cabbage webworm will be the more important key problem followed

<sup>1</sup> This was the situation at the time our work on the control of cabbage insects began. However, black rot, a bacterial disease, is now quite common in Hawaii, and causing considerable damage in some sections. Since this disease is bacterial and not likely to be affected by chemical control measures applied to the plant, the situation regarding the insects remains essentially as it was before black rot became prevalent.



by cabbage butterfly in a secondary place. At elevations above 1,000 feet cabbage webworm will be negligible and cabbage butterfly will be the key problem. At elevations of 4,000 feet cutworms are relatively important but do not rank as key problems.

Tomato has a number of insect problems from which it may suffer considerably, and, under humid conditions, has certain fungus diseases also. (We can omit the virus diseases from our present discussion since in the light of present knowledge they are not likely to be controlled or prevented by a program of chemical control in the near future.) Until the key problems are determined the control program may be aimed at any of eighteen species mentioned in the first three categories of Table 1 and capable of serious injury to the crop.

With the determination of the major insects and evaluation of corn earworm and melonfly as key problems the research program has been directed into these two main channels with the fungus diseases subsidiary key problems under wet conditions and the other insect problems subsidiary to the key problems. When control of the key insects is secured, many of the subsidiary problems are taken care of automatically by the control measures for the key problem while control of other subsidiary problems is incorporated with the measures for the key insects.

Celery is an example of yet another type of crop. On this crop the key problems are fungus diseases. Even though there are on celery two important insects, celery aphid and garden looper, control measures for these two insects are secondary and incorporated with those aimed at the diseases.

Study of the vegetable insects and research on their control has followed two governing principles, first the importance of the crop to the community and second the determination of the key problems on the important crops. Before the defense emergency the most important vegetable crops were tomato, head cabbage, green bean, and Irish potato. During the emergency period sweetpotato, carrot, cowpea, Chinese cabbage, lima bean, and sweet corn were added to the list of important crops. Following our entry into the war, lettuce, radish, chard, beets, celery, and other miscellaneous vegetables have been added because it became necessary for the Territory to produce more of its own perishable greens and, moreover, it became necessary for the home gardener to contribute his effort.

When possible we have utilized the biological control method in collaboration with entomologists of the Board of Agriculture and Forestry. But we have not had time, staff, or funds adequate to the needs of a satisfactory biological control project. It has been necessary to secure some measure of control in the minimum of time and we have secured it, in the main, by means of chemicals.

The results of much of the experimental work to date on the control of major insects have already been summarized in various progress notes, annual reports, and circulars of the Hawaii Agricultural Experiment Station and the Extension Service, and in papers presented before the Hawaiian Academy of Science (4) (5) (6) (7) (8) (9) (12) (15) (16) (17) (19). I shall not spend time here to discuss the experimental work in detail but shall restrict myself to mentioning briefly some of the more outstanding results.

### *Tomato*

In 1937 the opinion was commonly held by agriculturists that tomato bug, *Cyrtopeltis varians*, was likely to be a limiting factor to tomato production in Hawaii. In the years immediately following the establishment of the Entomology Department we were able to show that tomato bug is primarily an insect of low elevations and especially of the summer months. With the varieties of tomato then available, satisfactory commercial production of tomatoes was apparently not possible during the summer months at low elevations; the crop was commonly grown at elevations of 1,000 to 2,000 feet, and when grown at low elevations was produced in the winter months only.

With such a system of tomato production, tomato bug was not a serious problem because tomatoes were produced mainly in regions where the importance of the bug was negligible.

Up to 1939, 50 per cent of the tomato crop was commonly lost through corn earworm attack in spite of attempts to control it with sprays. In 1940 we established a control for corn earworm by means of cryolite and worked out combination treatments for this insect and others together with a control for fungus disease.

Corn earworm on tomato is no longer a nightmare to the farmer. It is now controllable to an extent approaching 100 per cent by means of cryolite, provided timing of the applications is satisfactory and application is thorough.

I have already referred to the increased importance of tomato bug following the introduction of the variety "Bounty." We have shown that tomato bug is controllable by means of pyrethrum, rotenone, and nicotine especially when applied in dust form and also by "Lethane." Because of the present world shortage of pyrethrum and rotenone we are concentrating on such nicotine dusts as will be compatible with cryolite. To date we have secured very satisfactory results with a nicotine-talc dust but our work is still in progress.

### *Lima bean*

A satisfactory control for bean-pod borer, *Maruca testulalis*, has been found in cryolite. Combination treatments of cryolite plus

nicotine or cryolite plus sulphur or all three materials will take care of most insect problems encountered on lima beans.

### *Cabbage*

In normal times most of our head cabbage and Chinese cabbage came from the islands of Maui and Hawaii where cabbage is grown at elevations of 2,000 feet to 4,000 feet. At these elevations cabbage webworm is not a problem; it is an insect of the low elevations.

With a cessation of inter-island shipments of vegetables following the attack on Pearl Harbor and the attempt to grow cabbage on Oahu, where arable lands are all below 1,000 feet, cabbage webworm has been a serious problem. It attacks the growing point and may ruin the plant completely. It attacks, in addition to head cabbage, broccoli, Chinese cabbage, spoon cabbage, mustards, turnip, daikon, radish, and various Oriental crucifers.

We have found that either rotenone or cryolite will control this insect. In general dusts are superior to sprays. As a result of these findings these crops can now be grown under an increasingly wide range of conditions under which it was formerly difficult to grow them.

The cabbage butterfly, a second important insect of cabbage, broccoli, and related plants, has been controlled by means of rotenone and also by arsenate of lead. Arsenate of lead has the greater powers of retention and, in commercial production, can be used in the early stages of growth so as to conserve rotenone. In the later stages of growth, rotenone only should be used. This is a safe non-poisonous insecticide which can be used by home gardeners on cabbage and broccoli throughout the growth of these crops.

### *Sweetpotato*

We have determined two satisfactory controls for sweetpotato leaf miner—a spray of diesel oil emulsion plus nicotine sulphate and a Paris green spray. (Diesel oil emulsion is the oil emulsion developed by Dr. Carter of the Pineapple Research Institute for control of pineapple mealy bug.)

### *Green beans*

We have worked out satisfactory controls for bean leafhopper, *Empoasca solana* De Long and bean capsid, *Pycnoderes quadrimaculatus*, pyrethrum plus sulphur dust, or sulphur dust alone for the leafhopper, nicotine or rotenone for the capsid. The quantitative records for a single experiment on the control of bean leafhopper involved over 121,000 leafhoppers.

The Chinese rose beetle which consumes the leaves has been in Hawaii for nearly half a century. Because the problem is complex and has many angles to it, time will not permit me to discuss it in detail. Suffice it to say that we are making good progress with it. We have shown that of materials studied to date, arsenate of lead is the only material that has any marked control on it. We are working on the correction of spray burn from arsenate of lead. Meanwhile we are continuing the search for additional materials, that will control the beetle, that do not have the weaknesses of arsenate of lead.

### *Beet and Chard*

For beet and chard we have developed a satisfactory combination treatment which will give almost 100 per cent control of the two major insects—beet webworm and broad mite, and in addition bean leafhopper should it be present.

### *Corn*

The mineral oil method of controlling corn earworm in sweet corn has been studied. It has been found that under Hawaiian conditions a modification of the method used in the mainland United States is necessary, for addition of insecticides to the oil causes a considerable amount of silk rotting.

### *Pepper*

As a result of our finding that a combination treatment of cryolite and sulphur for pepper weevil and broad mite will control these two devastating pests of pepper, pepper production in the Territory is increasing markedly.

All these developments are causing vegetable production to be placed on a more satisfactory basis. Not all the insect problems, however, are solved yet. Improvements in the control measures already developed can undoubtedly be made. But one can say, even now, that satisfactory measures of control have been developed for so many of our vegetable insects, that insect depredations can no longer be said to contribute a limiting factor to vegetable production.

The extent to which insect control has progressed in the past few years can be gauged in some measure by the insecticide sales. In 1938 when we tried to secure cryolite for our experimental work it was necessary for us to order it direct from the manufacturer. Our first rotenone was secured from Dr. Carter who had obtained a small quantity of timbo from Dr. Schmidt who purchased it in Brazil. Rotenone has proved to be the best, all round safe insecticide, for home gardeners who know little of the principles of insect-

ticidal control or of the precautions necessary in using insecticides likely to be poisonous to human beings. A combination dust of rotenone and sulphur is even better and is the best, safe all round insecticide mixture for use in home gardens in Hawaii. But supplies of rotenone are limited and the world shortage is already telling on local supplies.

The success which has attended our investigations demonstrating the value of cryolite for so many insect problems is reflected in the imports of cryolite to Hawaii over the past few years.

The importation of cryolite into Hawaii rose from nil in 1939 to 3,615 pounds in 1940 and to an average of 30,395 pounds per annum in 1941 and 1942. The sales in 1943 will be more than double the sales of last year.<sup>1</sup> County agents and farmers alike speak in glowing terms of the value of cryolite. Often have I had the remark made to me that cryolite is the most valuable single insecticide available at the present time in Hawaii for use in commercial vegetable production.

### Conclusion

I have traced the developments in the control of vegetable insects from the beginnings of applied entomology in Hawaii at the opening of the present century. I have traced them through the changing agriculture of the period, and the change of entomologists responsible for vegetable insect work through the period of lessened interest in the insects of vegetable crops to the present period of interest in vegetables for survival. I have touched on the changing scene as regards the insects present, the new insect immigrants and the new problems developed with changed conditions. I have mentioned briefly the control measures developed for many of our important insects. As time goes on, we shall undoubtedly bring more of the insects under control. The picture at present is bright. Nevertheless there is one aspect of the picture that needs watching. We are in very truth at the cross roads of the Pacific. We already possess economic insects from all parts of the earth. Commerce is increasing. Air transport has increased enormously. Since the Territory established its plant inspection and quarantine service in 1903 forty-three new vegetable insects have been recorded in Hawaii and thirteen of them have been recorded since 1938. If 43 species can become established in spite of a plant inspection and quarantine service it is not too much to say that increased vigilance will be needed in the years to come when normal trade is resumed and commercial air services continue to expand.

If, as I have suggested earlier, the increase in occurrence of new immigrant species of economic insects over the past ten or fifteen years is attributable to an increase in importations of vegetables

<sup>1</sup> Sales of cryolite for 1943 amounted to 45 tons.

over that period, might not one answer to the problem be to produce more vegetables locally and thus reduce importations?

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## Notes on Insects and Other Arthropods from the Islands of Molokai and Maui, Hawaii

BY N. L. H. KRAUSS

Board of Agriculture and Forestry

(Presented at the meeting of December 13, 1943)

The insects and other arthropods listed in this paper were collected on Molokai during the periods May 29 to June 5 and October 8 to 13, and on Maui June 5 to 13, 1943. The Thysanoptera have been reported on in another paper.<sup>1</sup> My thanks are extended to the following persons who have kindly identified most of the specimens: D. T. Fullaway (parasitic Hymenoptera), O. H. Swezey (Coleoptera, some of the Diptera, Cicadellidae, Delphacidae, Cixiidae), F. X. Williams (Hymenoptera, most of the Diptera), E. C. Zimmerman (weevils, Hemiptera), E. O. Essig (Aphididae), H. Morrison (Coccidae), L. M. Russell (Aleyrodidae), R. V. Chamberlin (Araneida) and H. E. Ewing and E. A. McGregor (Acarina). Species apparently here recorded for the first time from Molokai or Maui are marked with an asterisk.

### ARANEIDA

- \**Latrodectus geometricus* Koch, south central Molokai, May 31.
- \**Latrodectus mactans hesperus* Chamberlin and Ivie, south central Molokai, May 31.

### ACARINA

- Anystis* sp., probably *A. agilis* Bks., near edge of Waikolu Valley, Molokai, June 3, ex *Metrosideros* sp.; Wailuku, Maui, June 13, ex leaves of hibiscus.
- Tetranychus* sp., south central Molokai, May 31, ex leaves *Datura stramonium* L.
- Tetranychus* sp., nearest *bimaculatus* Harv., Kawela, Molokai, June 2, ex tomato leaves.

### ORTHOPTERA

#### Tettigoniidae

- Elimaea punctifera* (Walk.), 1, eastern Molokai, May 30.

<sup>1</sup> See p. 113.



## Gryllidae

*Paratrigonidium atroferrugineum* Brunn., 3, near edge of Waikolu Valley, Molokai, Oct. 10.

## Locustidae

*Attractomorpha ambigua* Bol., 1, eastern Molokai, May 30.

*Oxya chinensis* (Thunb.), 1, Haiku, Maui, June 7.

## Mantidae

*Tenodera angustipennis* Sauss., 1 egg mass with parasite exit holes, probably of *Podagrion mantis* Ashmead, Kaunakakai, \*Molokai, June 2; 1 nymph, Kaunakakai, June 4; 1 nymph, Wailuku, Maui, June 6; 1 nymph, Haiku, Maui, June 7.

## Blattidae

\**Diploptera dytiscoides* (Serv.), 1, Kaunakakai, Molokai, May 29.

\**Graptoblatta notulata* (Stål), 1, Iao Valley, Maui, June 6; 1, Hana, Maui, June 9.

\**Supella supellectilium* (Serv.), 1 Kaunakakai, Molokai, June 1, in house.

## HEMIPTERA

## Miridae

\**Buchaniella sodalis* (White), 1, Iao Valley, Maui, June 6.

*Cyrtopeltis varians* (Dist.), 5, Kaunakakai, Molokai, Oct. 8, ex *Gynandropsis pentaphylla* De C.; 10, Kaunakakai, Oct. 13; 3, south central Molokai, May 31; 1, Kawela, Molokai, June 2; 2, Haiku, Maui, June 7.

*Hyalopeplus pellucidus* (Stål), 1, Halawa Valley, Molokai, May 30; 1, south central Molokai, May 31; near edge of Waikolu Valley, Molokai, June 3 (1) and Oct. 10 (1); 1, Iao Valley, Maui, June 6; 3, Haiku, Maui, June 7.

\**Leucopoeila albofasciata* Reut., 1, near edge of Waikolu Valley, Molokai, June 3.

\**Physopleurella mundula* (White), 1, Iao Valley, Maui, June 6.

\**Pycnoderes quadrimaculatus* Guer., 2, Kamalo, Molokai, Oct. 11, ex bush bean leaves; 1, Ualapue, Molokai, Oct. 11; 5, Haiku, Maui, June 7; 7, Hana, Maui, June 9; 4, Nahiku, Maui, June 10.

*Sarona adonias* Kirk., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

## Anthocoridae

*Triphleps persequens* White, Kaunakakai, Molokai, May 29 (2), June 4 (3), and 5 (1).

## Reduviidae

*Empicoris rubromaculatus* Blackb., 1, south central Molokai, May 31; 4, Iao Valley, Maui, June 6.

*Zelus renardii* Kol., Kaunakakai, Molokai, May 29 (2) and June 4 (1); 1, south central Molokai, May 31; 1, Wailuku, Maui, June 6.

## Tingidae

*Teleonemia scrupulosa* Stål, 2, eastern Molokai, May 30; 1, Kaunakakai, Molokai, June 4; 2, Halawa Valley, Molokai, June 4; 6, Wailuku, Maui, June 6; 2, Kaupo, Maui, June 9.

## Lygaeidae

*Corizus hyalinus* (Fabr.), 1, Wailuku, Maui, June 6.

\**Gocoris punctipes* (Say), Kaunakakai, Molokai, May 29 (4) and June 4 (2).

\**Orthoea vineta* (Say), 2, south central Molokai, May 31; 8, near edge of Waikolu Valley, Molokai, June 3.

## Pentatomidae

*Oechalia pacifica* (Stål), 1, near edge of Waikolu Valley, Molokai, June 3.

## Cydnidae

*Geotomus pygmaeus* (Dallas), 1, eastern Molokai, May 30; 1, Kaunakakai, Molokai, June 4.

## HOMOPTERA

## Membracidae

\**Stictocephala festina* (Say), 2, eastern Molokai, May 30; 8, Kawela, Molokai, June 2; 1, Kaunakakai, Molokai, Oct. 8; 1, Hana, Maui, June 8.

## Cicadellidae

\**Bythoscopus robustus* (Uhler), 3, Kaunakakai, Molokai, June 4.

\**Empoasca solana* De L., Kaunakakai, Molokai, June 4 (2), June 5 (2); 5, Wailuku, Maui, June 13, ex leaves of castor bean.

\**Nesophrosyne perkinsi* (Kirk.), Hana, Maui, June 8 (4) and 10 (13).

\**Opsiuss stactogalus* (Amyot), 23, Kaunakakai, Molokai, Oct. 10, ex *Tamarix* sp.

## Flatidae

*Siphanta acuta* (Walk.), near edge of Waikolu Valley, Molokai, June 3 (3) and Oct. 10 (1); 1, Iao Valley, Maui, June 6; 1, Hana, Maui, June 9.

## Delphacidae

- Aloha ipomoeae* Kirk., 2, Halawa Valley, Molokai, June 4; Hana, Maui, June 8 (2) and 10 (2).  
 \**Leialoha lehuae mauiensis* Muir, 3, near edge of Waikolu Valley, Molokai, June 3.  
 \**Leialoha ohiae* (Kirk.), 1, near edge of Waikolu Valley, Molokai, June 3, ex *Metrosideros* sp.; 1, same area, Oct. 10.  
*Peregrinus maidis* (Ashm.), 19, Hoolehua, Molokai, June 1, ex corn plants; 3, Kaunakakai, Molokai, June 4; 12, Iao Valley, Maui, June 6; 12, Haiku, Maui, June 7; 1, Kaupo, Maui, June 9.  
*Perkinsiella saccharicida* Kirk., 1, Hana, Maui, June 8.

## Cixiidae

- Oliarus haleakalae* Kirk. ?, 1, near edge of Waikolu Valley, Molokai, June 3.  
*Oliarus kahavalu* Kirk., 2, Iao Valley, Maui, June 6.  
*Oliarus similis* var. *a* Giffard, near edge of Waikolu Valley, Molokai, June 3 (2), Oct. 10 (1).

## Aphididae

- Amphorophora sonchi* (Oestl.), Hoolehua, Molokai, June 1; Wailuku, Maui, June 6; Hana, Maui, June 8; all ex *Sonchus oleraceus* L.  
 \**Aphis gossypii* Glov., Hoolehua, Molokai, June 1, ex watermelon; Kawela, Molokai, June 2, ex *Crotalaria saltiana* Andr.; Wailuku, Maui, June 13, ex *Lagerstroemia indica* L.; Haiku, Maui, June 7, ex cucumber leaves, upland taro (*Colocasia esculenta* Schott) leaves and hibiscus flowers.  
 \**Aphis maidis* Fitch, Hoolehua, Molokai, June 1, ex corn.  
*Aphis medicaginis* Koch, Moomomi, Molokai, June 1, ex *Tribulus cistoides* L. leaves; Hana, Maui, June 8, ex *Vigna marina* (Burm.) Merr.  
 \**Aphis middletonii* Thomas, Hoolehua, Molokai, June 1, ex *Sonchus oleraceus* L.  
 \**Aphis tavaresi* Del Guer., Wailuku, Maui, June 6.  
 \**Macrosiphum rosae* (Linn.), Keanae, Maui, June 8, ex rose.  
 \**Macrosiphum solanifolii* (Ashm.), Olinda, Maui, June 12, ex *Hypochaeris radicata* L.  
*Myzus convolvuli* (Kalt.), Wailuku, Maui, June 13, ex *Phalaenopsis* sp.  
 \**Neophyllaphis araucariae* Takah., near edge of Waikolu Valley, Molokai, June 3; Hana, Maui, June 10; all from leaves *Araucaria excelsa* R. Br.

- \**Toxoptera aurantii* (Boyer), near edge of Waikolu Valley, Molokai, June 3, ex *Vaccinium* sp.; Wailuku, Maui, June 13, ex *Lagerstroemia indica* L.

## Aleyrodidae

- \**Bemisia giffardi* (Kot.), Kaunakakai, Molokai, June 4, ex leaves *Citrus* sp.; Iao Valley, Maui, June 6, ex leaves *Citrus* sp.  
 \**Dialeurodes kirkaldyi* (Kot.), Hana, Maui, June 9, ex leaves *Morinda citrifolia* L.  
 \**Pealius hibisci* (Kot.), Wailuku, Maui, June 13, ex leaves *Hibiscus* sp.  
*Trialeurodes vaporariorum* (Westw.), Hoolehua, Molokai, June 1, ex *Sonchus oleraceus* L.; Kawela, Molokai, June 2, ex tomato leaves; Wailuku, Maui, June 6, ex *Sonchus oleraceus* L.

## Coccidae

- \**Aspidiotus lataniae* Sign., Kalae, Molokai, June 1, ex conifer; Iao Valley, Maui, June 6, ex stems *Psidium guajava* L.  
 \**Chrysomphalus aonidum* (L.), Kaunakakai, Molokai, May 29, ex leaves *Eugenia jambolana* Lam.; Wailuku, Maui, June 13, ex leaves *Strelitzia reginae* Banks.  
 \**Coccus viridis* (Green), Iao Valley, Maui, June 6, ex leaves *Psidium guajava* L.; Wailuku, Maui, June 13, ex *Ixora macrothyrsa* (Teij. & Binn.)  
 \**Diaspis boisduvalii* Sign., Wailuku, Maui, June 13, ex *Cattleya* sp.  
*Phenacaspis* sp., presumably *sandwicensis* Fullaway, Wailuku, Maui, June 13, ex leaves *Nerium* sp.  
*Pseudococcus nipae* (Mask.), (as currently recognized), Haiku, Maui, June 7, ex *Psidium guajava* L.  
*Pseudococcus* sp. (*citri* group, probably *kraunhia* [Kuw.]), Hana, Maui, June 11, ex flower *Alpinia purpurata* (Veill.).  
*Pseudococcus* sp., Kaunakakai, Molokai, May 29, ex *Prosopis chilensis* (Molina) Stuntz. Dr. Morrison writes that neither this nor the following species is included in Miss Amy Suehiro's manuscript revision of the Hawaiian *Pseudococcus*.  
*Pseudococcus* sp., Halawa Valley, Molokai, May 30, ex *Agave rigida* Mill.  
*Pseudococcus* (*Ferrisia*) *virgatus* (Ckll.), Moomomi, Molokai, June 1, ex *Sida fallax* Walp.  
*Pulvinaria psidii* Mask., Halawa Valley, Molokai, May 30, ex *Morinda citrifolia* L. stem.

## COLEOPTERA

## Carabidae

- \**Bembidion niloticum batesi* Putz., 4, Kaunakakai, Molokai, May 29, on mud flats near shore.

- \**Tachys oahuensis* Blackb., 5, Kaunakakai Molokai, May 29, on mud flats near shore.

## Coccinellidae

- Azya luteipes* Muls., Kaunakakai, Molokai, June 4 (1) and 5 (1); Wailuku, Maui, June 6 (2) and 13 (2); 5, Iao Valley, Maui June 6.
- Coccinella abdominalis* Muls., 1, Ualapue, Molokai, Oct. 11.
- Coelophora inaequalis* (Fabr.), 1, Kaunakakai, Molokai, May 29; 1, south central Molokai, May 31; 1, Halawa Valley, Molokai, June 4; 1, Iao Valley, Maui, June 6; 1, Haiku, Maui, June 7.
- Cryptolaemus montrouzieri* Muls., Halawa Valley, Molokai, May 30 (1), and June 4 (1); 1, Kaunakakai, Molokai, June 4; 1, Iao Valley, Maui, June 6; Hana, Maui, June 9 (1) and 10 (1); 1, Nahiku, Maui, June 10.
- \**Curinus coeruleus* (Muls.), 4, Iao Valley, Maui, June 6; 1, Wailuku, Maui, June 6.
- \**Hyperaspis jocosus* (Muls.), 4, Iao Valley, Maui, June 6; 1, Wailuku, Maui, June 6; 1, Hana, Maui, June 8.
- \**Nephus pictus* (Gorh.), 2, south central Molokai, May 31; 1, Wailuku, Maui, June 6.
- Platyomus lividigaster* Muls., 1, eastern Molokai, May 30; 1, south central Molokai, May 31; 1, Hoolehua, Molokai, June 1; 1, Kawela, Molokai, June 2; 4, Kaunakakai, Molokai, Oct. 9.
- Rodolia cardinalis* (Muls.), 1, Iao Valley, Maui, June 6.
- Scymnus notescens* (Blackb.), 1, south central Molokai, May 31; 1, Hoolehua, Molokai, June 1, on watermelon plant; 3, Haiku, Maui, June 7.
- Scymnus vagans* (Blackb.), 1, Iao Valley, Maui, June 6; Hana, Maui, June 8 (1) and 9 (2); 1, Wailuku, Maui, June 13.
- Scymnus vividus* Sharp, Kaunakakai, Molokai, May 29 (1), June 4 (1), 5 (2) and 8 (1); 4, south central Molokai, May 31; 2, Kawela, Molokai, June 2.
- \**Sticholotis punctatus* Crotch, 4, Iao Valley, Maui, June 6.

## Mycetophagidae

- \**Litargus vestitus* Sharp, 1, Hana, Maui, June 9.

## Cucujidae

- Cryptomorpha desjardinsi* (Guer.), 1, Kaunakakai, Molokai, June 1, in house; 1, near edge of Waikolu Valley, Molokai, June 3; 1, Halawa Valley, Molokai, Oct. 12.

## Nitidulidae

- Carpophilus dimidiatus* (Fabr.), 1, Kawela, Molokai, June 2; 2, Haiku, Maui, June 7.

*Carpophilus hemipterus* (L.), 1, south central Molokai, May 31; 4, Hoolehua, Molokai, June 1; 3, Haiku, Maui, June 7.

*Carpophilus humeralis* (Fabr.), 3, Kaunakakai, Molokai, May 29; 3, south central Molokai, May 31; 1, Hoolehua, Molokai, June 1; 2, near edge of Waikolu Valley, Molokai, Oct. 10; 4, Haiku, Maui, June 7.

#### Lathridiidae

\**Coluocera maderae* Woll., 18, south central Molokai, May 31, in nests of *Paratrechina longicornis* (Latr.) (crazy ant).

*Coninomus nodifer* (Westw.), 1, Olinda, Maui, June 12, on *Rubus* sp.

#### Elateridae

*Conoderus exsul* (Sharp), 1, Wailuku, Maui, June 6; 2, Kaupo, Maui, June 9.

#### Bostrichidae

*Amphicerus cornutus* (Pallas), 1, south central Molokai, May 31.

*Sinoxylon conigerum* Gerst., 5, south central Molokai, May 31.

#### Scarabaeidae

*Adoretus sinicus* Burm., 1, south central Molokai, May 31; 1, Kaunakakai, Molokai, June 4; 1, Hana, Maui, June 11.

*Aphodius lividus* (Oliv.), 2, Kaunakakai, Molokai, June 3.

\**Ataenius cognatus* Lec., 5, Kaunakakai, Molokai, May 29.

*Saprosites pygmaeus* Harold, 13, Iao Valley, Maui, June 6.

#### Cerambycidae

*Ceresium unicolor* (Fabr.), 1, Kahakuloa, Maui, June 12.

*Sybra alternans* Wied., 3, Moomomi, Molokai, June 1; 1, Halawa Valley, Molokai, Oct. 12; 1, Nahiku, Maui, June 10.

#### Chrysomelidae

*Diachus auratus* (Fabr.), 1, Halawa Valley, \*Molokai, May 30; 3, Kaunakakai, Molokai, June 4; 1, Wailuku, Maui, June 6.

\**Epitrix parvula* (Fabr.), 1, Haiku, Maui, June 7.

*Lema trilineata californica* Schaeff., 1, south central Molokai, May 31, ex *Datura stramonium* L.; 2, Wailuku, Maui, June 6, ex *Brugmansia arborea* (L.).

#### Bruchidae

*Bruchus amicus* Horn, 4, Kawela, Molokai, June 2; Kaunakakai, Molokai, June 4 (3) and Oct. 9 (3); 1, Iao Valley, Maui, June 6.

\**Bruchus chinensis* (L.), 1, Kaunakakai, Molokai, June 5; 3, Haiku, Maui, June 7.

- Bruchus limbatus* Horn, 1, Wailuku, Maui, June 6.  
*Bruchus prosopis* Lec., 1, south central Molokai, May 31.  
 \**Bruchus pruininus* Horn, 1, Kaunakakai, Molokai, Oct. 9.  
*Bruchus sallaei* Sharp, 1, Kaunakakai, Molokai, May 29; 8, Kawela Molokai, June 2, ex pods *Acacia farnesiana* (L.).  
*Megacerus alternatus* Brid., 1, Hoolehua, Molokai, June 1; 4, Halawa Valley, Molokai, Oct. 12.

## Tenebrionidae

- \**Ammophorus insularis* Boh., 2, Kaunakakai, Molokai, May 29.  
*Blapstinus dilatatus* Lec.?, 7, Kaunakakai, Molokai, May 29; 1, south central Molokai, May 31.  
*Epitragus diremptus* Karsch, 2, south central Molokai, May 31; 1, Hoolehua, Molokai, Oct. 9.  
*Gonocephalum seriatum* (Boisd.), 2, Moomomi, Molokai, June 1.  
*Platydemus subfascia* (Walk.), 9, Halawa Valley, Molokai, May 30.

## Anthribidae

- Araecerus fasciculatus* (De G.), 1, south central Molokai, May 31; Kaunakakai, Molokai, June 5 (2) and Oct. 9 (1); 1, Wailuku, Maui, June 6; 5, Iao Valley, Maui, June 6.  
*Araecerus vieillardii* (Montr.), 1, Kaunakakai, \*Molokai, Oct. 9; 1, Haiku, Maui, June 7; 1, Hana, Maui, June 8.

## Curculionidae

- Anthonomus eugenii* Cano, 2, Kaunakakai, Molokai, May 29; 1, south central Molokai, May 31; 1, Iao Valley, Maui, June 6; 2, Haiku, Maui, June 7.  
*Athesapecta cyperi* Marshall, 1, Wailuku, Maui, June 6.  
*Euscepes postfasciatus* (Fairm.), 1, Hana, Maui, June 8.  
*Orydemus fusiforme* Woll., 6, Halawa Valley, Molokai, May 30; 36, Iao Valley, Maui, June 6.  
*Pantomorus godmani* (Crotch), 2, near edge of Waikolu Valley, Molokai, June 3; 1, Halawa Valley, Molokai, June 4; 1, Wailuku, Maui, June 6; 2, Haiku, Maui, June 7.  
 \**Pentarthrum obscurum* Sharp, 10, Iao Valley, Maui, June 6.  
*Stenotrupis prolixa* (Sharp), near edge of Waikolu Valley, Molokai, June 3 (1), and Oct. 10, ex dead frond stems *Cibotium* sp. (9).

## Scolytidae

- \**Ericryphalus sylvicola* (Perk.), 1, Iao Valley, Maui, June 6.  
*Hypothenemus insularis* Perk., 1, Iao Valley, Maui, June 6; 1, Haiku, Maui, June 7.  
 \**Xyleborus kraatzi* Eich., 1, Hana, Maui, June 8.

## LEPIDOPTERA

## Pyralididae

*Hymenia fascialis* (Cram.), 1, Halawa Valley, Molokai, June 4.

## Lycaenidae

*Cosmolyce boetica* (L.), 1, Halawa Valley, Molokai, June 4; 1, Haiku, Maui, June 7.

## DIPTERA

## Ceratopogonidae

\**Forcypomyia ingrani* Carter, 4, near edge of Waikolu Valley, Molokai, Oct. 10.

## Culicidae

*Culex quinquefasciatus* Say, 1, Olinda, Maui, June 12.

## Sciaridae

*Neosciara* sp., 3, south central Molokai, May 31; 1, Hana, Maui, June 8; 2, Olinda, Maui, June 12.

## Pipunculidae

*Pipunculus* sp., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

## Syrphidae

*Allograpta obliqua* (Say), 2, near edge of Waikolu Valley, Molokai, June 3.

*Eumerus marginatus* Grims., 1, Halawa Valley, Molokai, June 4.

\**Ischiodon scutellaris* (Fabr.), 1, Kahakuloa, Maui, June 12.

*Lathyrophthalmus aeneus* (Scop.), 2, Kaunakakai, Molokai, May 29.

\**Toxomerus marginatus* (Say), 4, near edge of Waikolu Valley, Molokai, June 3; 1, Haiku, Maui, June 7.

*Volucella obesa* (Fabr.); 1, south central Molokai, May 31.

## Tachinidae

*Archytas cirphis* Curr., 1, near edge of Waikolu Valley, Molokai, June 3; 1, Nahiku, Maui, June 10.

\**Chaetogaedia monticola* (Big.), 3, near edge of Waikolu Valley, Molokai, June 3.

\**Eucelatoria armigera* (Coq.), 1, Olinda, Maui, June 12.

\**Leucostoma atra* Towns., 2, near edge of Waikolu Valley, Molokai, June 3.



## Sarcophagidae

\**Helicobia heliciis* (Townsend), 2, Kawela, Molokai, June 2.

## Calliphoridae

\**Chrysomya rufifascies* (Macq.), 1, Nahiku, Maui, June 10.

## Anthomyiidae

*Lispa metatarsalis* Thom., 1, near edge of Waikolu Valley, Molokai, June 3.

*Lispocephala* sp., 1, near edge of Waikolu Valley, Molokai, June 3.

*Lispocephala* sp., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

\**Ophyra chalcogaster* Wied., 1, Hana, Maui, June 9.

## Borboridae

*Leptocera ferruginata* Stenl., 5, Kaunakakai, Molokai, May 29.

*Leptocera* sp., 4, Olinda, Maui, June 12.

## Sciomyzidae

*Sciomyza hawaiiensis* Grims., 1, Halawa Valley, \*Molokai, June 4; 1, Wailuku, Maui, June 6; 1, Iao Valley, Maui, June 6.

## Ortalidae

*Scholastes bimaculatus* Hend., 1, Kaunakakai, Molokai, June 5.

## Trypetidae

*Ceratitis capitata* (Wied.), 1, Iao Valley, Maui, June 6.

*Dacus cucurbitae* Coq., 3, south central Molokai, May 31; 1, Iao Valley, Maui, June 6; 1, Kaupo, Maui, June 9; 1, Wailuku, Maui, June 13.

*Eutreta xanthochaeta* Aldr., 1, Halawa Valley, Molokai, June 4; 1, Nahiku, Maui, June 10.

## Ephydridae

*Brachydeutera hebes* Cress., 5, Kawela, Molokai, June 2.

\**Notophila insularis* Grims., 7, south central Molokai, May 31.

*Procanace nigroviridis* Cress., 2, Halawa Valley, Molokai, May 30.

\**Scatella bryani* Cress., 3, Kawela, Molokai, June 2.

\**Scatella hawaiiensis* Grims., 1, Olinda, Maui, June 12.

*Scatella warreni* Cress., 10, Halawa Valley, \*Molokai, May 30; 1, Kahakuloa, Maui, June 12.

## Drosophilidae

\**Drosophila spinofemora* P. & W., 1, Halawa Valley, Molokai, June 4; 1, Haiku, Maui, June 7; 3, Hana, Maui, June 9.

## Agromyzidae

*Liriomyza pusilla* (Meig.), 2, near edge of Waikolu Valley, Molokai, Oct. 10.

*Ophiomyia lantanae* (Frogg.), 1, Halawa Valley, Molokai, June 4.

## Milichiidae

*Milichiella lacteipennis* (Loew), 1, south central Molokai, May 31.

## Chloropidae

\**Rhodesiella tarsalis* Adams, Hana, Maui, June 8 (1), June 9 (1).

## HYMENOPTERA

## Braconidae

\**Apanteles dignus* Mues., 1, Kawela, Molokai, June 2, reared from lepidopterous larva in tomato leaf.

*Apanteles* sp. (parasite of *Opogona*), 1, Halawa Valley, Molokai, June 4; 1, near edge of Waikolu Valley, Molokai, Oct. 10; 1, Hana, Maui, June 9.

\**Chelonus blackburni* Cam., 1, Kaupo, Maui, June 9.

\**Ischiogonus pallidiceps* Perk., 1, south central Molokai, May 31; 2, Iao Valley, Maui, June 6.

\**Opius lantanae* Bridw., 1, Kaupo, Maui, June 9.

## Ichneumonidae

*Amblyteles* sp., 1, near edge of Waikolu Valley, Molokai, June 3.

*Casinaria infesta* (Cress.), 1, Kaunakakai, Molokai, June 4.

*Cremastus flavo-orbitalis* (Cam.), 1, near edge of Waikolu Valley, Molokai, June 3; 1, Kaupo, Maui, June 9.

*Idechthis* sp., 2, eastern Molokai, May 30; 1, south central Molokai, May 31; 1, Wailuku, Maui, June 6; 1, Hana, Maui, June 9; 1, Kahakuloa, Maui, June 12.

*Pristomerus hawaiiensis* Perk., 1, near edge of Waikolu Valley, Molokai, Oct. 10; 1, Hana, Maui, June 9; 1, Kaupo, Maui, June 9.

## Scelionidae

*Anteris nigricornis* Ashm., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

## Chalcididae

*Brachymeria obscurata* (Walk.), 1, Kaunakakai, Molokai, June 4; 1, Kainalu, Molokai, Oct. 12; Hana, Maui, June 8 (1) and 10 (1).

*Dirhinus giffardii* Silv., 1, Kaunakakai, Molokai, June 4.

\**Podagrion mantis* Ashmead, 1, south central Molokai, May 31.  
This may be the first authentic record of this mantid parasite in the Hawaiian Islands.

*Stomatocerus pertorvum* Gir., 1, Hana, Maui, June 8; 1, Kaupo, Maui, June 9; 1, Kahakuloa, Maui, June 12.

#### Eurytomidae

*Eurytoma* sp., 1, Haiku, Maui, June 7.

#### Eupelmidae

\**Cerambycobius cushmani* Crawf., 1, Wailuku, Maui, June 6.

*Eupelmus* sp., 1, Iao Valley, Maui, June 6.

#### Encyrtidae

\**Aenasius advena* Comp., 3, Moomomi, Molokai, June 1; Kaunakakai, Molokai, June 5 (1) and Oct. 9 (1); 1, Hana, Maui, June 10.

*Encyrtus infelix* (Embl.), 1, near edge of Waikolu Valley, Molokai, June 3.

#### Eulophidae

*Astichus* sp., 1, near edge of Waikolu Valley, Molokai, June 3.

*Euderus metallicus* (Ashm.), 7, near edge of Waikolu Valley, Molokai, June 3; 4, Olinda, Maui, June 12.

*Pseudophelminus vagans* Timb., 1, Iao Valley, Maui, June 6; 1, Hana, Maui, June 10.

*Tetrastichus giffardianus* Silv., 1, Kaunakakai, Molokai, June 5.

*Tetrastichus* sp., 1, Iao Valley, Maui, June 6.

#### Formicidae

*Camponotus (Tanaemyrmex) variegatus hawaiiensis* For., 3, Kaunakakai, Molokai, May 29.

*Cardiocondyla emeryi* For., Kaunakakai, Molokai, June 4 (3) and Oct. 8 (1); 1, Halawa Valley, Molokai, June 4; Hana, Maui, June 8 (5) and 9 (1).

*Leptogenys falcigera insularis* Smith, 4, Iao Valley, Maui, June 6.

\**Monomorium minutum liliuokalanii* For., 9, Hoolehua, Molokai, June 1; 1, Hana, Maui, June 9.

\**Paratrechina longicornis* (Latr.), 18, south central Molokai, May 31; 9, Kawela, Molokai, June 2.

*Paratrechina (Nylanderia) bourbonica hawaiiensis* (For.), 1, Halawa Valley, Molokai, June 4; Hana, Maui, June 8 (6) and 9 (5).

\**Paratrechina (Nylanderia) sharpii* (For.), 1, Hana, Maui, June 9.

*Pheidole megacephala* (Fabr.), 2, Hana, Maui, June 9.

\**Plagiolepis exigua* For., 7, Halawa Valley, Molokai, May 30.

*Ponera perkinsi* For., 2, Halawa Valley, Molokai, May 30.

*Technomyrmex albipes* (F. Smith), 5, Halawa Valley, Molokai, May 30.

*Tetramorium guineense* (Fabr.), 3, eastern Molokai, May 30; 8, Hana, Maui, June 10.

#### Mimesidae

*Nesomimesa nitida* Perk., 1, near edge of Waikolu Valley, Molokai, Oct. 10.

#### Eumenidae

*Odynerus homeogaster* Perk., 1, Nahiku, Maui, June 10.

*Odynerus molokaiensis* Perk., 2, near edge of Waikolu Valley, Molokai, Oct. 10.

*Odynerus nigripennis* (Holm.), 2, Kaupo, Maui, June 9.

*Odynerus purpurifera* Perk., 1, eastern Molokai, May 30.

*Odynerus sandwichensis* D. T., 1, Kaupo, Maui, June 9.

*Pachodynerus nasidens* (Latr.), 1, Kawela, Molokai, June 2; 2, Kaunakakai, Molokai, June 4; 1, Wailuku, Maui, June 6; 1, Kaupo, Maui, June 9.

#### Vespidae

*Polistes fuscatus aurifer* (Sauss.), 1, Kaunakakai, Molokai, June 4.

*Polistes olivaceus* (De G.), 1, Haiku, Maui, June 7.

#### Dryinidae

*Pseudogonatopus perkinsi* (Ashm.), 1, near edge of Waikolu Valley, Molokai, June 3, ex *Metrosideros* sp.

#### Crabronidae

*Nesocrabro adspectans* (B. & C.), 1, near edge of Waikolu Valley, Molokai, Oct. 10.

*Xenocrabro mandibularis* (Sm.), 1, near edge of Waikolu Valley, Molokai, Oct. 10.

*Xenocrabro molokaiensis* (Perk.), 1, near edge of Waikolu Valley, Molokai, June 3.

#### Trypoxylonidae

*Pison hospes* Sm., 1, Kaunakakai, Molokai, June 4.

\**Pison iridipennis* Sm., 2, south central Molokai, May 31; 1, Kawela, Molokai, June 2.

*Trypoxylon bicolor* Smith, 1, south central Molokai, May 31; 1, Kawela, Molokai, June 2.

#### Sphecidae

\**Astata bella* Cress., 1, Kaunakakai, Molokai, Oct. 9.

## Scoliidae

*Campsomeres marginella modesta* (Smith), 1, Kaunakakai, Molokai, June 4; 1, Kaupo, Maui, June 9.

## Larridae

*Notogonidea subtessellata* (Smith). 1, Kawela, Molokai, June 2.

## Hylaeidae

*Nesoprosopis facilis* (Sm.), 2, near edge of Waikolu Valley, Molokai, Oct. 10; 1, Hana, Maui, June 10.

## Megachilidae

*Megachile gentilis* Cress., 1, Kawela, Molokai, June 2; 2, Kaunakakai, Molokai, Oct. 13.

*Megachile schauinslandi* Alf., Kaunakakai, Molokai, June 4 (1), Oct. 8 (1) and 13 (2).

## Apidae

*Apis mellifera* L., 1, south central Molokai, May 31.

## Some First Records of Aphids in Hawaii\*

BY WM. C. LOOK AND ETHEL LUCAS McAFEE

Hawaii Agricultural Experiment Station

(Presented at the meeting of March 8, 1943)

Since the reestablishment of an Entomology Department in the Hawaii Agricultural Experiment Station, University of Hawaii, in 1937, numerous observations have been made of the insects of diversified crops. These observations have established the presence in Hawaii of a number of insects not formerly recorded here. The present contribution gives the first records of eight species of aphids.

### *Amphorophora sonchi* (Oestlund)

This species was determined by Professor Essig in June 1940 as *Amphorophora sonchi* (Oestlund). Timberlake (7)† recorded an aphid *A. lactucae* (Kaltenbach) on *Sonchus oleraceus* (common sow thistle) in 1922. This aphid is apparently the same species as *A. sonchi* (Oestlund). *A. sonchi* has been observed breeding freely on *S. oleraceus*. Alates have been found on *Solanum tuberosum* (potato) and *Ipomea batatas* (sweetpotato) as well as on *Lycopersicon esculentum*. To date, all of our collections have been made during the cooler months of the year.

### *Aphis rumicis* Linnaeus

This species occurs commonly on various legumes in other parts of the world. In Hawaii it breeds on *Phaseolus limensis* (lima bean), but *A. medicaginis* Koch is the more common and more important species. The determination of both species has been made by Professor Essig.

*A. rumicis* is an important vector of several virus diseases (5, 6), the most important of which is probably the bean mosaic.

### *Cavariella capreae* (Fabricius)

The yellow willow aphid has a rather wide distribution throughout the temperate regions (2). Except for this first collection at Kohala, Hawaii, this aphid has not been found on carrots in the Territory. Observations to date indicate that *Brevicoryne brassicae* (Linnaeus) is a more important species on carrot than is *C.*

\* Published with the approval of the Director as Technical Paper No. 108 of the Hawaii Agricultural Experiment Station.

† Numbers in parentheses refer to the bibliography.

Table 2. Some First Records of Aphids in Hawaii

SPECIES	DATE	HOST	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Amphorophora souchi</i> (Oestlund)	Dec. 15, 1939	<i>Lycopersicon esculentum</i> (tomato)	Laualalei, Oahu	W. C. Look	Alate	E. O. Essig
<i>Aphis rumicis</i> Linnaeus	Jan. 23, 1938	<i>Erechtites valerianaeifolia</i> § (fireweed)	Lower Tantalus, Oahu	E. McAfee	Alate Apterous	E. McAfee
<i>Brachycolus heraclei</i> Takahashi	Dec. 6, 1940	<i>Apium graveolens dulce</i> (celery)	Waialua, Oahu	F. G. Holdaway	Alate Apterous	E. O. Essig
<i>Caraviella capreae</i> (Fabricius)	Jan. 25, 1939	<i>Daucus carota sativa</i> (carrot)	Kohala, Hawaii	G. Marvin	Alate Apterous	S. H. Au
<i>Idiosiphium rosaeifolium</i> Theobald	Nov. 22, 1940	<i>Rosa</i> sp. (rose)	Manoa, Oahu	W. C. Look	Alate Apterous	E. O. Essig
<i>Micromyzus formosus</i> (Takahashi)	Dec. 20, 1939	<i>Allium cepa</i> (onion) <i>Allium schoenoprasum</i> (chive)	Kaneohe, Oahu	W. C. Look	Alate Apterous	E. O. Essig
<i>Myzus convolvuli</i> (Kaltenbach)	Feb. 2, 1941	<i>Euphorbia</i> sp. <i>Spathoglottis plicata</i> (wild ground orchid)	Waikane-Kahana Trail, Oahu	E. McAfee	Apterous Apterous	E. O. Essig E. O. Essig
<i>Rhopalosiphum pseudobrassicae</i> (Davis)	Oct. 20, 1939	<i>Lycopersicon esculentum</i> (tomato)	Kaneohe, Oahu	W. C. Look	Alate	E. O. Essig

\* Previously published (4).

† See Proc. Haw. Ent. Soc., 11(3): 270, 1943.

‡ Previously published (3, 4).

§ Det. by Dr. H. St. John.

*capreae*. Reference to the specimens on which this record is based has already been made by D. T. Fullaway.<sup>1</sup>

### **Macrosiphum rosaefolium** Theobald

This species was found breeding freely on roses. Aphids collected a year previously on these same rose bushes were *Myzus circumflexus* (Buckton). It appears that *M. rosaefolium* may, therefore, be a comparatively recent introduction into Hawaii.

### **Micromyzus formosanus** (Takahashi)

This species has since been observed attacking onion at several different places on Oahu. An aphid was reported attacking green onion at Makaweli, Kauai in March 1941. It would appear that *M. formosanus* may have established itself on Kauai in recent years.

### **Myzus convolvuli** (Kaltenbach)

This species has a wide range of hosts elsewhere; it has been found on important crops such as *Apium graveolens dulce* (celery), *Lactuca sativa* (lettuce), *Pisum sativum* (pea), *Solanum tuberosum* (potato), and *Lycopersicon esculentum* (tomato). It is an important vector of western celery mosaic (5) and narcissus mosaic (1).

### **Rhopalosiphum pseudobrassicae** (Davis)

The turnip aphid has become established as an important insect of *Brassica oleracea botrytis* (broccoli), *B. pekinensis* (Chinese cabbage), and *Raphanus sativus longipinnatus* (daikon). It is a vector of several strains of viruses, of which bean mosaic and cauliflower mosaic are the most important (5, 6).

#### ACKNOWLEDGMENT

We wish to thank Dr. F. G. Holdaway for his valuable suggestions and direction in the preparation of this paper. We are indebted to Professor E. O. Essig and S. H. Au for assistance in making the determinations.

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## New Host Records of Aphids in Hawaii\*

BY WM. C. LOOK AND ETHEL LUCAS MCAFEE

Hawaii Agricultural Experiment Station

(Presented at the meeting of April 12, 1943)

In connection with the observations which have been made by the Entomology Department of the Hawaii Agricultural Experiment Station of the insects of diversified crops, many insects have been recorded on plants which were not formerly recorded as hosts in Hawaii.

The present contribution gives new host records of aphids secured during the past few years. It includes host records of eight species only recently recorded as occurring in Hawaii (9).<sup>1</sup>

### *Amphorophora sonchi* (Oestlund)

This species breeds in abundance on *Sonchus oleraceus*. Up to the present, only alates have been found on sweet potato and tomato. Only further observations can determine whether this species is capable of breeding on these plants.

### *Aphis gossypii* Glover

The melon aphid is probably the most common aphid in Hawaii. It has a wide range of hosts. It was found breeding on every host given in table 3. It breeds in great numbers on *Crotalaria mucronata*, sweet potato, and tomato.

This species is the carrier of several destructive viruses. Holmes (8) lists seven different viruses. The more important diseases are the cucumber mosaic, the bean mosaic, cauliflower mosaic, and two celery mosaics. It also transmits the yellow dwarf virus of onion and the celery calico virus (8, 12).

### *Aphis maidis* Fitch

The corn leaf aphid was found breeding on asparagus, papaya, summer squash, and tomato. Only alates were found on pole bean and potato. Further observations may determine whether *A. maidis* is capable of breeding on these other plants also.

This species transmits the viruses of sugar cane mosaic, cucumber mosaic, yellow dwarf of onion, southern celery mosaic and maize mosaic (8).

\* Published with the approval of the Director as Technical Paper No. 109 of the Hawaii Agricultural Experiment Station.

<sup>1</sup> Numbers in parentheses refer to the bibliography.

# New Host Records of Aphids in Hawaii

Table 3

Key: § Observed—\* Previously published (7)—† Previously published (6)—‡ Determined by Dr. H. St. John

SPECIES	HOST	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Amphorophora sonchi</i> (Oestlund)	<i>Ipomoea batatas</i> (L.) Poir. (sweetpotato)	Jan. 16, 1941	Poamoho, Oahu	W. C. Look	Alate	E. McAfee
	<i>Lycopersicon esculentum</i> Mill. (tomato)	Jan. 24, 1941	Kipapa, Oahu	W. C. Look	Alate	E. McAfee
		Dec. 15, 1939	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
	<i>Sonchus oleraceus</i> L. (common sow thistle)	Dec. 15, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
		Jan. 1, 1940	Puuloa, Oahu	W. C. Look	Alate	E. O. Essig
<i>Aphis gossypii</i> Glover	<i>Sonchus oleraceus</i> L. (common sow thistle)	Jan. 26, 1941	Koko Head, Oahu	E. McAfee	Alate, apterous	E. McAfee
		Feb. 6, 1941	Puuloa, Oahu	E. McAfee	Alate, apterous	E. McAfee
		Sept. 15, 1938	Kona, Hawaii	M. Masuda	Apterous	E. McAfee
		Jan. 17, 1940	Lualualei, Oahu	W. C. Look	Apterous	E. O. Essig
		Feb. 8, 1940	Kailua, Oahu	W. C. Look	Alate	E. O. Essig
	<i>Catleya</i> sp. (cultivated orchid)	Feb. 8, 1940	Koko Head, Oahu	W. C. Look	Alate	E. O. Essig
		Feb. 28, 1940	Pupukea, Oahu	W. C. Look	Alate	E. McAfee
		Feb. 7, 1941	Upper Makiki, Oahu	A. C. Browne	Apterous	E. McAfee
		Apr. 3, 1939	Poamoho, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Sept. 21, 1940	Kipapa, Oahu	E. McAfee	Alate, apterous	E. McAfee
<i>Erechtites valerianaeifolia</i> D.C. (fireweed)	Oct. 9, 1940	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee	
	Jan. 24, 1941	Kipapa, Oahu	W. C. Look	Alate	E. McAfee	
	Jan. 29, 1941	Kaneohe, Oahu	W. C. Look	Alate, apterous	E. McAfee	

SPECIES	Host	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Aphis gossypii</i> Glover	<i>Lycopersicon esculentum</i> Mill. (tomato)	Feb. 13, 1941	Kahalani, Oahu	W. C. Look	apterous Alate,	E. McAfee
		Sept. 12, 1939	Kahuku, Oahu	W. C. Look	apterous Alate	E. McAfee
		Oct. 20, 1939	Koko Head, Oahu	W. C. Look	Alate	E. O. Essig
		Nov. 22, 1939	Lualualei, Oahu	W. C. Look	Alate	S. H. Au
		Sept. 25, 1940	Waipahu, Oahu	W. C. Look	Alate,	E. McAfee
					apterous Alate,	E. McAfee
		Jan. 29, 1941	Kaneohe, Oahu	W. C. Look	apterous Alate,	E. McAfee
		Feb. 8, 1940	Pensacola, Oahu	W. C. Look	Alate,	E. McAfee
		Apr. 19, 1940	Lualualei, Oahu	W. C. Look	apterous Alate	E. McAfee
		Aug. 8, 1939	Waipahu, Oahu	W. C. Look	Apterous	S. H. Au
<i>Aphis maidis</i> Fitch	<i>Passiflora edulis</i> Sims (passion fruit) ‡ <i>Phaseolus vulgaris</i> L. (pole bean) <i>Asparagus officinalis</i> L. (asparagus) * <i>Carica papaya</i> L. (papaya) <i>Cucurbita pepo</i> L. (summer squash) * <i>Lycopersicon esculentum</i> Mill. (tomato) ‡ <i>Phaseolus vulgaris</i> L. (pole bean)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	S. H. Au
		Aug. 1, 1939	Waipahu, Oahu	W. C. Look	Alate,	E. McAfee
					apterous	
		Apr. 7, 1939	Poamoho, Oahu	W. C. Look	Apterous	E. McAfee
		Apr. 3, 1941	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
		Sept. 6, 1939	Lualualei, Oahu	W. C. Look	Alate,	E. McAfee
					apterous	
		Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate,	E. McAfee
		Oct. 20, 1939	Koko Head, Oahu	W. C. Look	apterous Alate	E. McAfee
		Oct. 27, 1939	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
		Jan. 15, 1940	Puuloa, Oahu	W. C. Look	Alate	E. O. Essig
		Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	E. McAfee

## New Host Records of Aphids in Hawaii

Table 3—Continued

SPECIES	HOST	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Aphis maidis</i> Fitch	<i>Solanum tuberosum</i> L. (potato)	Dec. 15, 1939	Poamoho, Oahu	W. C. Look	Alate	E. McAfee
<i>Aphis medicaginis</i> Koch	* <i>Astragalus officinalis</i> L. (asparagus)	Aug. 29, 1939	Waipahu, Oahu	W. C. Look	Alate, apterous	R. McAfee
	<i>Carica papaya</i> L. (papaya)	Feb. 15, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Aug. 23, 1940	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Mar. 7, 1941	Kailua, Oahu	W. C. Look	Alate, apterous	E. McAfee
	<i>Erechtites valerianifolia</i> DC. (fireweed)	Sept. 21, 1940	Kipapa, Oahu	E. McAfee	Alate,	E. McAfee
	<i>Ipomoea batatas</i> (L.) Poir. (sweetpotato)	Oct. 9, 1940	Waipahu, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Dec. 12, 1940	Lualualei, Oahu	W. C. Look	Apterous	E. McAfee
		Jan. 4, 1941	Kipapa, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Jan. 24, 1941	Wahiawa, Oahu	W. C. Look	Alate, apterous	E. McAfee
	<i>Lycopersicon esculentum</i> Mill. (tomato)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Apterous	E. McAfee
<i>Aphis middletonii</i> Thomas	<i>Solanum tuberosum</i> L. (potato)	Nov. 22, 1939	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
		Mar. 13, 1940	Kaaawa, Oahu	W. C. Look	Alate	S. H. Au
		Sept. 21, 1940	Poamoho, Oahu	W. C. Look	Apterous	E. McAfee
	* <i>Carica papaya</i> L. (papaya)	Feb. 13, 1940	Kahalaui, Oahu	W. C. Look	Alate, apterous	E. O. Essig
		Feb. 15, 1940	Lualualei, Oahu	W. C. Look	Alate	S. H. Au

SPECIES	HOST	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Aphis middletonii</i> Thomas	* <i>Ipomoea pes-caprae</i> Mill. (tomato)	Dec. 15, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
<i>Aphis rumicis</i> Linnaeus	<i>Erechtites valerianaeifolia</i> DC.† (fireweed)	March 8, 1940	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
	<i>Nolopanax guilfoylei</i> (C. & M.) Merrill (panax)	Jan. 23, 1938	Lower Tantalus, Oahu	E. McAfee	Alate, apterous	E. McAfee
	<i>Phaseolus limensis</i> Macf. (lima bean)	March 14, 1941	Kailua, Oahu	L. C. Bishop	Alate, apterous	E. McAfee
	<i>Ipomoea batatas</i> (L.) Poir. (sweetpotato)	Apr. 21, 1939	Waialua, Oahu	W. C. Look	Alate, apterous	E. O. Essig
<i>Aphis sacchari</i> Zehntner	<i>Ipomoea batatas</i> (L.) Poir. (sweetpotato)	Feb. 4, 1941	Pearl City, Oahu	W. C. Look	Alate	E. McAfee
	<i>Ipomoea pes-caprae</i> Mill. (tomato)	Feb. 6, 1941	Puuloa, Oahu	W. C. Look	Alate	E. McAfee
	† <i>Phaseolus vulgaris</i> L. (pole bean)	Oct. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	S. H. Au
	<i>Solanum tuberosum</i> L. (potato)	Oct. 27, 1939	Waipahu, Oahu	W. C. Look	Alate	E. O. Essig
	<i>Sonchus oleraceus</i> L. (common sow thistle)	Dec. 13, 1939	Lualualei, Oahu	W. C. Look	Alate	E. O. Essig
	<i>Apium graveolens</i> L. (celery)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
<i>Brachycolus heraclei</i> Takahashi		Mar. 29, 1940	Poamoho, Oahu	W. C. Look	Alate	S. H. Au
	<i>Daucus carota</i> L. (carrot)	Feb. 6, 1941	Puuloa, Oahu	E. McAfee	Alate	E. McAfee
		Dec. 6, 1940	Waialua, Oahu	F. G. Holdaway	Alate, apterous	E. O. Essig
<i>Cavariella cuprae</i> (Fabricius)		May 22, 1941	Lahaina, Maui	F. Ako	Alate, apterous	E. McAfee
<i>Macrostiphium solanifolii</i> (Ashmead)		Jan. 25, 1939	Kohala, Hawaii	G. Marvin	Alate, apterous	S. H. Au
	<i>Brassica chinensis</i> L. (white mustard cabbage)	Mar. 27, 1940	Lualualei, Oahu	W. C. Look	Alate, apterous	E. McAfee
	<i>Brassica oleracea botrytis</i> L. (broccoli)	March 20, 1940	Waipahu, Oahu	E. McAfee	Alate	E. McAfee

Key: § Observed—\* Previously published (7)—† Previously published (6)—‡ Determined by Dr. H. St. John.

## New Host Records of Aphids in Hawaii

Table 3—Continued

SPECIES	HOST	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Macrosiphum solanifolii</i> (Ashmead)	<i>Carica papaya</i> L. (papaya)	March 9, 1939	Poamoho, Oahu	W. C. Look	Alate, apterous	W. C. Look
		Feb. 15, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Feb. 28, 1940	Pupukea, Oahu	W. C. Look	Alate	E. McAfee
		Mar. 13, 1941	Lualualei, Oahu	W. C. Look	Alate	W. C. Look
	<i>Ipomoea batatas</i> (L.) Poir. (sweetpotato)	Feb. 4, 1941	Pearl City, Oahu	W. C. Look	apterous Alate,	E. McAfee
		Feb. 6, 1941	Aiea, Oahu	W. C. Look	apterous Alate	E. McAfee
	<i>Lactuca sativa</i> L. (lettuce)	Feb. 4, 1941	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
	<i>Lycopersicon esculentum</i> Mill. (tomato)	Apr. 14, 1938	Waipahu, Oahu	F. G. Holdaway	apterous Alate,	S. H. Au
		Dec. 28, 1939	Pupukea, Oahu	W. C. Look	apterous Alate,	E. McAfee
		Jan. 15, 1940	Puuloa, Oahu	W. C. Look	apterous	E. McAfee
		Feb. 19, 1940	Central Kona, Hawaii	T. Ihara	Alate,	E. McAfee
		Mar. 13, 1940	Kaaawa, Oahu	W. C. Look	apterous Alate,	E. McAfee
		Mar. 5, 1941	Waiawa, Oahu	F. Okumura	apterous Alate,	E. McAfee
		Mar. 20, 1940	Waipahu, Oahu	E. McAfee	apterous Alate,	E. McAfee
	<i>Pisum sativum</i> L. <i>macro-</i> <i>carpon</i> Ser. (edible- podded pea)	July 13, 1939	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
	<i>Solanum melongena</i> L. (eggplant)	Apr. 10, 1940	Kailua, Oahu	M. Masuda	apterous	E. McAfee

SPECIES	Host	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Macrosiphum solanifolii</i> (Ashmead)	<i>Solanum tuberosum</i> L. (potato)	Mar. 30, 1938	Waipahu, Oahu	F. G. Holdaway	Alate, apterous	S. H. Au
		Feb. 6, 1939	Poamoho, Oahu	W. C. Look	Alate, apterous	S. H. Au
	<i>Sonchus oleraceus</i> L. (common sow thistle)	Feb. 6, 1941	Puuloa, Oahu	E. McAfee	Alate	E. McAfee
<i>Macrosiphum rosae</i> Theobald	<i>Rosa</i> sp. (rose)	Nov. 22, 1940	Manoa, Oahu	W. C. Look	Alate, apterous	E. O. Essig
<i>Micromyzus formosanus</i> (Takahashi)	† <i>Phaseolus vulgaris</i> L. (pole bean)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Apterous	E. O. Essig
	<i>Allium cepa</i> L. (onion)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate, apterous	E. O. Essig
		Mar. 25, 1940	Waipahu, Oahu	W. C. Look	Apterous	E. McAfee
		Mar. 10, 1941	Wahiawa, Oahu	F. Okumura	Apterous	E. McAfee
		Apr. 14, 1941	U. H., Manoa, Oahu	W. C. Look	Apterous	E. McAfee
	<i>Allium schoenoprasum</i> L. (chive)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate, apterous	E. O. Essig
<i>Myzus circumflexus</i> (Buckton)	<i>Carica papaya</i> L. (papaya)	Jan. 17, 1940	Lualualei, Oahu	W. C. Look	Apterous	E. O. Essig
		Feb. 8, 1940	Kailua, Oahu	W. C. Look	Alate, apterous	E. O. Essig
	<i>Rosa</i> sp. (rose)	Nov. 2, 1939	Manoa, Oahu	W. C. Look	Apterous	E. O. Essig
<i>Myzus conroleuli</i> (Kaltenbach)	<i>Euphorbia</i> sp. <i>Spathoglottis plicata</i> Bl. (wild ground orchid)	Feb. 2, 1941	Waikane-Kahana Trail, Oahu	E. McAfee	Apterous	E. O. Essig
	<i>Arctium lappa</i> L. (gobo— great burdock)	Sept. 9, 1940	Waimea, Hawaii	E. McAfee	Alate, apterous	E. O. Essig
<i>Myzus persicae</i> (Sulzer)	<i>Beta vulgaris</i> L. (garden beet)	Apr. 16, 1941	Kahala, Oahu	W. C. Look	Apterous	E. McAfee
	<i>Brassica pekinensis</i> Rupr. (Chinese cabbage)	Dec. 7, 1939	Kipapa, Oahu	F. Okumura	Alate, apterous	E. McAfee

Key: § Observed—\* Previously published (7)—† Previously published (6)—‡ Determined by Dr. H. St. John.



## New Host Records of Aphids in Hawaii

Table 3—Continued

SPECIES	HOST	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Myzus persicae</i> (Sulzer)	<i>Crotalaria mucronata</i> Desv. (rattlebox)	Apr. 13, 1939	Poamoho, Oahu	W. C. Look	Alate, apterous	E. McAfee
	<i>Ipomoea batatas</i> (L.) Poir. (sweetpotato)	Oct. 9, 1940	Poamoho, Oahu	W. C. Look	Apterous	E. McAfee
		Dec. 20, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Jan. 29, 1941	Koko Head, Oahu	W. C. Look	Alate, apterous	E. McAfee
		Feb. 4, 1941	Pearl City, Oahu	W. C. Look	Alate	E. McAfee
		Feb. 6, 1941	Puniloa, Oahu	W. C. Look	Alate, apterous	E. McAfee
	<i>Lactuca sativa</i> L. (lettuce)	Sept. 9, 1940	Waimea, Hawaii	E. McAfee	Alate, apterous	E. O. Essig
		Feb. 4, 1941	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
		Oct. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	E. O. Essig
		Oct. 27, 1939	Waipahu, Oahu	W. C. Look	Alate	E. O. Essig
<i>Pentalonia nigroaurerrosa</i> Coquerel		Dec. 15, 1939	Kahuku, Oahu	W. C. Look	Alate	E. O. Essig
		Mar. 8, 1940	Lualualei, Oahu	W. C. Look	Alate	E. McAfee
		Mar. 13, 1940	Kaaawa, Oahu	W. C. Look	Alate	E. O. Essig
		Mar. 27, 1943	Manoa, Oahu	W. C. Look	Apterous	W. C. Look
		Apr. 18, 1939	Lualualei, Oahu	W. C. Look	Alate, apterous	E. O. Essig
	‡ <i>Phaseolus vulgaris</i> L. (pole bean)	Aug. 8, 1939	Waipahu, Oahu	W. C. Look	Alate	E. McAfee
		Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	E. McAfee
	<i>Raphanus sativus</i> L. <i>longi-</i> <i>pinnatus</i> Bailey (daikon)	Sept. 9, 1940	Waimea, Hawaii	E. McAfee	Alate, apterous	E. O. Essig
	<i>Colocasia esculenta</i> (L.) Schott. (taro)	Sept. 6, 1939	Manoa, Oahu	E. McAfee	Alate	E. McAfee

SPECIES	HOST	DATE	LOCALITY	COLLECTOR	STAGE	IDENTIFIED BY
<i>Rhopalosiphum nymphaeae</i> (Linnaeus)	<i>Lycopersicon esculentum</i> Mill. (tomato)	Sept. 12, 1939	Kahuku, Oahu	W. C. Look	Alate	E. McAfee
	‡ <i>Phaseolus vulgaris</i> L. (pole bean)	Dec. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	S. H. Au
	<i>Solanum tuberosum</i> L. (potato)	Jan. 16, 1941	Poamoho, Oahu	W. C. Look	Alate	E. McAfee
	<i>Brassica oleracea botrytis</i> L. (broccoli)	Mar. 20, 1940	Waipahu, Oahu	F. G. Holdaway	Alate	E. O. Essig
<i>Rhopalosiphum pseudobrassicae</i> (Davis)	<i>Brassica pekinensis</i> Rupr. (Chinese cabbage)	Dec. 7, 1939	Kipapa, Oahu	F. Okumura	Alate, apterous	E. O. Essig
	<i>Raphanus sativus</i> L. longi- pinatus Bailey (daikon)	Apr. 10, 1940	Lualualei, Oahu	W. C. Look	Alate, apterous	E. O. Essig
	<i>Lycopersicon esculentum</i> Mill. (tomato)	Oct. 20, 1939	Kaneohe, Oahu	W. C. Look	Alate	E. O. Essig
	<i>Calophyllum inophyllum</i> L. (kamani)	Feb. 26, 1941	Manoa, Oahu	E. McAfee	Alate, apterous	E. O. Essig
<i>Toxoptera aurantii</i> (Fonscolombe)	<i>Lycopersicon esculentum</i> Mill. (tomato)	June 12, 1940	Waipahu, Oahu	W. C. Look	Alate	E. O. Essig

Key: § Observed—\* Previously published (7)—‡ Previously published (6)—† Determined by Dr. H. St. John

**Aphis medicaginis** Koch

The bean aphid generally breeds freely on legumes. On every host recorded in table 3, it was found breeding. It has been observed breeding in abundance on asparagus, firewood, papaya, and sweet-potato.

This species has been found to be one of the vectors of bean mosaic (12).

**Aphis middletonii** Thomas

This species has been reported elsewhere to be primarily a root feeder and has also been found at the bases of plants (2). In Hawaii, it was observed breeding on young leaves of papaya. Only alates were found on tomato.

It is one of the vectors of cauliflower mosaic and western celery mosaic (8).

**Aphis rumicis** Linnaeus

This aphid is an important species on beans in the United States. Adults and young have been observed on lima bean only once at Waialua, Oahu. Other host records were on fireweed and *Nothopanax guilfoylei*.

*A. rumicis* is a vector of bean mosaic, pea mosaic, sugar beet mosaic, western celery mosaic, and yellow dwarf disease of onion (8). It also transmits the virus of white clover mosaic (12).

**Aphis sacchari** Zehntner

In the records of the sugar cane aphid given in table 3, only alates were found. Only further observations can determine whether this species is capable of breeding on any of these plants.

**Brachycolus heraclei** Takahashi

This aphid was first recorded from the Orient. Patch (11) lists five species of food-plants of this aphid. They are *Apium graveolens*, *Coriandrum sativum*, *Cryptotaenia canadensis*, *Cryptotaenia japonica*, and *Heracleum* sp.

**Cavariella capreae** (Fabricius)

This species has been reported from Europe, South America, and the United States (2). It has been shown to be a vector of cauliflower mosaic and western celery mosaic diseases (8).

**Macrosiphum rosaefolium** Theobald

This aphid was originally described from Egypt. In 1931, it was collected on roses in California (3). Patch (11) also records *Rosa* as a food-plant of this aphid.

**Macrosiphum solanifolii** (Ashmead)

The potato aphid breeds freely on potato and tomato. It has been found breeding on eggplant, lettuce, Chinese pea, and papaya. Although Timberlake (13) reported an abundance of this aphid on *Sonchus*, only alates have been collected by us from this host.

*M. solanifolii* is second only to *Myzus persicae* in importance as a vector of plant virus diseases. Holmes (8) mentions eleven different strains of viruses which it transmits. Smith (12) records an additional three, less important viruses. Cucumber mosaic, tobacco mosaic, bean mosaic, and spindle-tuber of potato are the most important diseases. The virus of woodiness disease of passion fruit is also transmitted by the potato aphid (10).

**Micromyzus formosanus** (Takahashi)

Up to the present, this species has been found breeding in abundance only on onion and chives. The additional record was made on bean plants growing near a bed of chives which were heavily infested with *M. formosanus*. It would appear that these aphids were not breeding on beans.

**Myzus circumflexus** (Buckton)

The lily aphid has been reported to have a wide range of hosts elsewhere (2). In Hawaii, it has been found breeding freely on papaya and *Rosa*.

*M. circumflexus* is an important vector of cucumber mosaic, potato leaf-roll, tobacco mosaic, cauliflower mosaic, and western celery mosaic (8). Bawden (1) includes, in addition to these diseases, the mosaic of *Commelina*, *Hyoscyamus* "3" virus, potato "A" virus, and potato "Y" virus.

**Myzus convolvuli** (Kaltenbach)

Except for this one record made at the Waikane-Kahana trail, the foxglove aphid has not been collected by us in Hawaii.

*M. convolvuli* is the vector of two mosaic diseases (8) and is believed to be the vector of *Freesia* mosaic (12). Holmes (8) mentions *Myzus pseudosolani* Theobald as a vector of cucumber mosaic, potato leaf-roll, and tobacco mosaic. Essig (2) considers *M. pseudosolani* Theobald as a synonym of *M. convolvuli* (Kaltenbach).

**Myzus persicae** (Sulzer)

The green peach aphid is one of the most important species in Hawaii. On all of the hosts recorded in table 3, it was found breed-

ing. It has been observed breeding freely on Chinese cabbage, head cabbage, daikon, eggplant, papaya, pepper and potato.

*M. persicae* is the most important aphid vector of virus diseases. It is reported by Holmes (8) to be capable of transmitting 19 different strains of plant viruses. Smith (12) mentions five additional strains and Bawden (1) includes the mosaic of *Commelina*. Noble (10) has shown that it is a vector of woodiness diseases of passion fruit. The more important diseases are cucumber mosaic, tobacco mosaic, potato spindle-tuber, potato leaf-roll, bean mosaic, sugar beet mosaic, cauliflower mosaic, and turnip mosaic.

### ***Pentalonia nigronervosa* Coquerel**

Although the first records of banana aphid on taro are of an alate, other observations indicate that it breeds freely on this host. It also breeds freely on ginger. Only winged individuals have been recorded on tomato. These alates apparently have migrated from their normal hosts to tomato.

*P. nigronervosa* is the chief vector of banana bunchy-top disease and abaca bunchy-top disease (1). It also transmits the virus of southern celery mosaic (8).

### ***Rhopalosiphum nymphaeae* (Linnaeus)**

This species breeds readily on taro. Only alates have been recorded on potato and pole bean. Further collecting may show whether this species is capable of breeding on these plants.

### ***Rhopalosiphum pseudobrassicae* (Davis)**

The turnip aphid breeds in abundance on Chinese cabbage, daikon, and other crucifers. Gould (5) reported this species breeding on broccoli in Virginia in 1930. Only alates were found on tomatoes. This aphid is probably a recent introduction into the Territory.

*R. pseudobrassicae* transmits the viruses of bean mosaic, cauliflower mosaic and stock mosaic (8). It is also the vector of yellow dwarf of onion (12).

### ***Toxoptera aurantii* (Fonscolombe)**

Recently this species has been found breeding freely on the flowers of mango at Kalihi, Oahu.

Petri has suggested that the "little-leaf" disease of citrus is spread by an aphid *Toxoptera aurantis* Boyer<sup>1</sup> (12) : 556.

<sup>1</sup> Probably a misprint for *T. aurantii*; Boyer and Fonscolombe refer to the same author, whose name was Boyer de Fonscolombe. (Ed.)

### **Vesiculaphis caricis** (Fullaway)

This aphid has been reported breeding on a species of *Carex* (4). Only alates have been found by us on tomato. These winged aphids may have flown from their natural hosts to tomato.

### SUMMARY

New hosts, for Hawaii, are recorded of the following twenty species of aphids: *Amphorophora sonchi* (Oestlund), *Aphis gossypii* Glover, *Aphis maidis* Fitch, *Aphis medicaginis* Koch, *Aphis middletonii* Thomas, *Aphis rumicis* Linnaeus, *Aphis sacchari* Zehntner, *Brachycolus heraclei* Takahashi, *Cavariella capreae* (Fabricius), *Macrosiphum rosaefolium* Theobald, *Macrosiphum solanifolii* (Ashmead), *Micromyzus formosanus* (Takahashi), *Myzus circumflexus* (Buckton), *Myzus convolvuli* (Kaltenbach), *Myzus persicae* (Sulzer), *Pentalonia nigronervosa* Coquerel, *Rhopalosiphum nymphaeae* (Linnaeus), *Rhopalosiphum pseudobrassicae* (Davis), *Toxoptera aurantii* (Fonscolombe) and *Vesiculaphis caricis* (Fullaway).

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Thrips from Maui and Molokai<sup>1</sup>

K. SAKIMURA

Pineapple Research Institute

AND

N. L. H. KRAUSS

Board of Agriculture and Forestry<sup>2</sup>

(Presented at the meeting of November 8, 1943)

A collection of thrips was made by Krauss at widely scattered localities on the islands of Maui and Molokai during the period from May 29 to June 13, 1943 and again on Molokai from October 8 to 12, 1943, and the specimens were examined by Sakimura. Since no extensive collections have been made on these two islands, very little of the thysanopterous fauna, especially of the introduced species in the cultivated lowlands, has been known. The present collection contributes somewhat toward a further knowledge. A complete list of species now known from these two islands is given at the end of the paper; 24 forms are listed from Maui and 25 from Molokai. The most significant discovery was of the establishment on Molokai of the California bean thrips (*Hercothrips fasciatus* [Perg.]), whose invasion into the Hawaiian Islands has long been feared.

**Organothrips bianchii** Hood\* Honouliwai, Molokai: *Colocasia esculenta* (taro), petioles.\* Halawa Valley, Molokai: *Colocasia esculenta* (taro), petioles.

Moderate and heavy infestations of this unique thrips were found at the respective localities. This species was first discovered on Oahu and Hawaii during 1939 (3) (7) and its distribution now includes Molokai.

**Heliothrips haemorrhoidalis** Bouché (greenhouse thrips)Olinda, Maui: *Rubus penetrans*, leaves and stems.*Hypochoeris radicata* (gosmore), leaves.

Peach, leaves.

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\* Throughout this paper a single asterisk indicates that collection was made during October, 1943.



\* Near edge of Waikolu Valley, Molokai: *Vaccinium calycinum* (ohelo), leaves.

A localized heavy infestation was found at Olinda on *Rubus penetrans*, which is a cultivated but escaped species, and on the two other plants growing nearby in a gulch with mixed undergrowth and a few trees. Another heavy infestation was found on ohelo, a native fruit shrub, in the rain forest at the edge of Waikolu Valley. Despite the fact that this species has been known in the Hawaiian Islands since 1892 (1), and it was stated as early as 1921 that "it is quite abundant in the forest areas of various islands" (5), actual records of collection were from Kauai, Hawaii, and Oahu only. There is an unpublished record that this species was collected from boysenberry (*Rubus loganobaccus* hybrid?) at the Haleakala (Maui) Substation of the Hawaii Agricultural Experiment Station in 1939 by Dr. F. G. Holdaway. These are apparently the first records from Maui and Molokai. All five plants are new Hawaiian host records.

#### **Hercotthrips fasciatus** (Perg.) (bean thrips)

Kaunakakai, Molokai: *Argemone alba* var. *glauca* (prickly poppy), leaves, buds, and flowers.

This is apparently the first discovery of this species in the Hawaiian Islands. It was probably introduced from California on plant material, possibly oranges. This is the second immigrant thrips discovered within the past year, the first being *Frankliniella* sp. Verification has been requested of Mr. Dudley Moulton for the determination of *H. fasciatus*.

A very heavy infestation was found, on June 4, on several plants of this host growing together on the bank of a dry stream bed just outside of the town. The vegetation in the vicinity was typical of dry, weedy uncultivated areas, and there were few cultivated plants in the vicinity. Further examinations were made in June of the same host plant in other parts of Kaunakakai as well as quite extensively in the area between Hoolehua and the south coast, but no other infestation was found.

In October a far more extensive search of the island for this species was made. Known host plants including the prickly poppy, sow thistle (*Sonchus oleraceus*), cotton, bean, pea, and also many potential hosts were examined in Kaunakakai and vicinity, and in many other parts of the island but no thrips of this species were found. The original infestation in Kaunakakai apparently died out during the hot dry weather of summer, but there seems a bare possibility that the species will reappear during the next rainy season.

**Hercinothrips femoralis** (Reuter) (banded greenhouse thrips)

Although this species was not collected on these trips, there is an unpublished record that it was found at Wailua, Maui on young fruits of banana causing extensive silver and bronze scars. The specimens were collected by Mr. J. Shigeta in January, 1943 and forwarded by Dr. F. G. Holdaway for determination. This species has been known in the Hawaiian Islands since 1930 (12), but has only been recorded from Oahu, so that this is the first record from Maui. Although this thrips has frequently been collected from various greenhouse plants, collection from outdoor plants has been previously made only once—on *Emilia sonchifolia* (18). Two other new outdoor records are from *Plantago major* at Kalihi, Oahu, collected by Mr. W. C. Look in March, 1943, and from *Emilia sonchifolia*, on which they were flourishing, in a pineapple field at Waipio, Oahu in November, 1942. These records indicate that this species, as on the mainland, occasionally builds up high populations outdoors under certain conditions. Banana and *Plantago* are new Hawaiian host records.

**Selenothrips rubrocinctus** (Giard) (red-banded thrips)

Wailuku, Maui: *Mangifera indica* (mango), leaves.

Eastern Molokai: *Schinus terebinthifolius* (Christmas berry tree), leaves.

The infestation on mango was heavy. Although the occurrence of such a common species, known in the Hawaiian Islands since 1909 (6), might be expected on every island, specimens from Maui and Molokai have never been previously recorded. Hawaii and Lanai are still not on the distribution list.

**Frankliniella** sp.

Haiku, Maui: Hibiscus, flowers.

Olinda, Maui: *Rubus penetrans*, flowers.

Kaunakakai, Molokai: Hibiscus, flowers.

\* *Ipomoea cairica* var. *lineariloba* (Molokai morning glory), flowers.

\* *Gossypium brasiliense* (cotton), flowers.

\* Near Kahualelepulu, Molokai: *Argemone alba* var. *glauca* (prickly poppy), flowers.

\* Hoolehua, Molokai: *Argemone alba* var. *glauca* (prickly poppy), flowers.

Moomomi, Molokai: *Tribulus cistoides* (nohu), flowers.

This is the same species that was recorded under the name of *F. near occidentalis* (Perg.) when first discovered on Oahu during

August, 1924 (15). Evidence indicates that this must be a recent immigrant species from a source not yet known. This species is an extremely polyphagous feeder, mainly on flowers, and no known Hawaiian species has a comparably wide host range. The formal determination of the species has not yet been received from Dr. J. D. Hood. More details on its host range, distribution, populations, life history, and inability to transmit the yellow spot virus will be reported in other papers.

This species has now been discovered on Maui and Molokai, and its adaptability in a new territory is very significant. Although many flowers known to be its hosts were examined during June, it was found only on three plants at four places and the infestations were generally light except the one at the dry sandy beach of Moomomi. Since this is definitely a dry land species, the low general populations must have been due partly to the season and partly to the districts where collections were made. However, the second collection made on Molokai during October and additional collections from Maui made by Mr. K. I. Hanson and Dr. F. G. Holdaway indicate that this species is as common and abundant on these islands during the dry season as it is on Oahu. Heavy and moderate infestations were found by Mr. Hanson on hibiscus flowers at Lahaina in July and August, and at Mala and Haiku in October, and by Dr. Holdaway on eggplant flowers at Lahaina in August.

**Taeniothrips simplex** Morison (gladiolus thrips)

Haiku, Maui: *Gladiolus*, leaves.

A moderate infestation was found of the famous gladiolus thrips which has been established on Maui since 1932 (4). There was no opportunity to examine gladiolus on Molokai where its presence has not yet been reported.

**Thrips hawaiiensis** (Morgan) and **T. hawaiiensis** f. *imitator* Pr.

(Hawaiian thrips)

Kahakuloa, Maui: *Vitex trifolia* var. *simplicifolia* (polinalina), flowers.

Iao Valley, Maui: *Aleurites moluccana* (kukui), flowers.

Haiku, Maui: *Samanea saman* (monkeypod), flowers.

Nahiku, Maui: *Psidium guajava* (guava), flowers.

Hana, Maui: *Dioclea violacea* (maunaloa), flowers.

Olinda, Maui: *Rubus penetrans*, flowers.

Kaunakakai, Molokai: *Batis maritima*, flowers.

Hibiscus, flowers.

*Calotropis gigantea* (crown flower), flowers.

\* *Ipomoea cairica* var. *lineariloba* (Molokai morning glory), flowers.

Mapulehu, Molokai: *Dioclea violacea* (maunaloa), flowers.

Near edge of Waikolu Valley, Molokai: Rose, flowers.

Kalae, Molokai: *Acacia confusa*, flowers.

\* Hoolehua, Molokai: *Argemone alba* var. *glauca* (prickly poppy), flowers.

These are very common flower thrips in the Hawaiian Islands and were frequently collected from various hosts on these trips. Populations were generally high on these hosts except on the ones in the drier sections and on those collected during October. This indicates that their preferred habitats apparently are wet or shady areas which is quite contrary to the preference of the other flower thrips, *Frankliniella* sp. Specimens from Molokai have not been recorded before, but their distribution now definitely includes all the Hawaiian Islands. The record from Hawaii is of specimens collected from cotton at Kona during 1928 (8). These species are also widely distributed among the Pacific islands. New local host records are polinalina, kukui, monkeypod, maunaloa, *Rubus penetrans*, *Batis*, crown flower, Molokai morning glory, *Acacia confusa*, and prickly poppy.

These species were originally described under the name of *Euthrips hawaiiensis* Morgan from specimens collected at Honolulu during 1909 (10), but later were transferred by Moulton to the genus *Taeniothrips* (11), which is the familiar name to the local entomologists. Priesner subsequently separated them into two groups: one with non-segmented styles—*Thrips hawaiiensis*; and the other with 2-segmented styles—*Thrips hawaiiensis* f. *imitator* (16). Sakimura has long known that an incidental number of the local specimens have non-segmented styles but has used only the name of the original species instead of separate names, because Priesner's reference has not been available to be consulted. After critical examination of many local specimens collected on these trips as well as of other collections, it was found that the predominating species is *imitator* and it is desirable to use separate names to distinguish the two forms. In the June collection alone, 91 out of the 107 individuals were *imitator*. A mixed colony was sometimes found on a single host plant but always *hawaiiensis* was in lesser numbers and a pure colony of *hawaiiensis* has not yet been encountered. Among a series of *hawaiiensis*, the true form—styles of both antennae non-segmented—was scarce. The majority were transitional forms, such as individuals either with partially segmented styles of both antennae, or a 2-segmented style of one antenna and a partially segmented style of the other, or a non-segmented style of one and a partially segmented style of the other. In addition, another anomalous antenna rarely found was 6-segmented, with shorter total length, shorter and narrower third

segment without sense cone, prolonged fifth segment, and non-segmented style. One specimen with both antennae of this type and another with one antenna of this type and the other of the normal 8-segments were found among the present material. It will be desirable to run a breeding experiment of these different forms to know the true interrelationships between them, that will provide a ground for clarifying the nomenclature of these two forms as is apparently necessary on the basis of the field population data.

**Thrips tabaci** Lind. (onion thrips)

Iao Valley, Maui: Onion, leaves.

Haiku, Maui: Onion, leaves.

**Thrips (Isoneurothrips) australis** (Bag.)

\* Near edge of Waikolu Valley, Molokai: *Eucalyptus* sp., flowers.

A large number of specimens was collected from the flowers. This species was first discovered on Oahu during 1938 (2), and is rather common on *Eucalyptus* flowers. This is the first record from Molokai.

**Thrips (Isoneurothrips) sp.**

Near edge of Waikolu Valley, Molokai: *Broussaisia* sp., flowers.

A heavy infestation of this probably indigenous species was found on this native plant in the rain forest area at 3500 feet elevation. This species is very closely related to the indigenous *T. (I.) antennatus* (Moulton) but is undoubtedly distinct from all the Hawaiian species of this genus and probably is an undescribed species. The final determination has been requested of Mr. Moulton whose report is expected in the near future.

**Thrips (Isoneurothrips) sp.**

\* Near edge of Waikolu Valley, Molokai: *Raillardia molokaiensis* (naenae), leaves.

A heavy infestation of another probably indigenous species was found on another native plant in the rain forest within a short distance of the site where the preceding species was collected. The present species is also distinct from all Hawaiian species of this genus but somewhat resembles *T. (I.) dubautiae* (Moulton) and probably is an undescribed species. However, final determination is withheld until further study will be made.

**Thrips (*Microcephalothrips*) *abdominalis*** Cwfd. (composite thrips) Iao Valley, Maui: *Tithonia diversifolia* (tree tithonia), flowers.

Infestation was moderate. The first record from Maui is of a collection made at Makena during 1940 on a previous trip by Krauss (9). Another moderate infestation was found by Mr. B. Kumabe on dahlia flowers at Wailuku, Maui in October, 1943. Specimens were forwarded by Dr. F. G. Holdaway for determination. This species has been known in the Hawaiian Islands since 1926 (11) and is distributed on Oahu and Kauai also.

**Oedemothrips *laticeps*** Bag.<sup>3</sup>

\* Near edge of Waikolu Valley, Molokai: sweeping.

A single specimen was collected by sweeping among various shrubs and trees in the rain forest. The type specimens of this indigenous species were collected in 1896 and 1900 at three localities on Oahu (1). As far as published records are concerned, the next specimen was collected in 1935 again from Oahu (13), so that this is the fifth collection and the first record from Molokai.

**Hoplothrips *flavitibia*** Moulton

Iao Valley, Maui: *Aleurites moluccana* (kukui), under bark of dead log.

Many specimens, including immature stages, were collected in a typical habitat for this common phloeophilous (bark-loving) species of the Hawaiian forest. All except one female were brachypterous forms. According to published records, this is the first record from Maui as it has been known only from Oahu where the type specimens were collected in 1927 (11). Since this species is also distributed on other Pacific islands (14), there is little doubt that it will be found on other islands of the Hawaiian group.

**Haplothrips *fusca*** Moulton

Kaunakakai, Molokai: *Batis maritima*, flowers.

Near edge of Waikolu Valley, Molokai: *Cladium angustifolium* (a sedge), flowers.

Moderate infestations were observed at both places. *Batis* was growing in a shoreside swamp and *Cladium* was found along a roadside in the rain forest. The type specimens were collected from *Batis maritima* on Oahu during 1927 (11), and the second collection was made in a wind trap on Molokai during 1933 (17)

<sup>3</sup> This species has been referred to *Nesothrips hawaiiensis* Kirk. See paper by F. A. Bianchi in this issue (p. 31) [Ep.].

but the host was not known there. The next specimens were caught, again on the type host, at Koko Head, Oahu during 1940. *Batis* and *Cladium* are the only known hosts and the former seems to be the preferred one. It is interesting to note that a colony mixed with *Haplothrips gowdeyi* was observed at Koko Head and also on an unknown host at Kaunakakai on these trips.

**Haplothrips gowdeyi** (Frank.) (black flower thrips)

Hana, Maui: *Plantago major* (plantain), flowers.

*Dioclea violacea* (maunaloa), flowers.

Wailuku, Maui: *Cenchrus* sp. (sandbur), flowers.

Kaunakakai, Molokai: *Commelina diffusa* (honohono), flowers.

*Calotropis gigantea* (crown flower), flowers.

Near edge of Waikolu Valley, Molokai: *Taraxacum officinale* (dandelion), flowers.

Kawela, Molokai: Tomato, leaves.

*Cenchrus* sp. (sandbur), flowers.

*Zinnia pauciflora*, flowers.

Moomomi, Molokai: *Tribulus cistoides* (nohu), flowers.

Hoolehua, Molokai: *Verbesina encelioides* (golden crown beard), flowers.

\* *Argemone alba* var. *glauca* (prickly poppy), flowers.

This is an extremely common and abundant thrips in the Hawaiian Islands and many specimens were collected from various hosts on these trips. The first specimen, mentioned under the name of *Anthothrips usitatus* Bag., was collected on Hawaii in 1892 (1), and many have been collected since from all the islands. This species is also widely distributed among the Pacific islands. Maunaloa, crown flower, dandelion, *Zinnia pauciflora*, nohu, and prickly poppy are new local host records.

LIST OF THRIPS KNOWN FROM MAUI AND MOLOKAI

<i>Terebrantia</i>	Maui	Molokai
<i>Aeolothrips fasciatus</i> (Linn.).....	×	
<i>Organothrips bianchii</i> Hood.....		×**
<i>Heliothrips haemorrhoidalis</i> Bouché.....	×**	×**
<i>Hercotothrips fasciatus</i> (Perg.).....		×**
<i>Hercinothrips femoralis</i> (Reuter).....	×**	
<i>Selenothrips rubrocinctus</i> (Giard).....	×**	×**
<i>Anaphothrips swezeyi</i> Moulton.....		×
<i>Frankliniella</i> sp. ....	×**	×**
<i>Taeniothrips alliorum</i> Pr. ....	×	×
<i>Taeniothrips frici</i> (Uzel) .....	×	
<i>Taeniothrips simplex</i> Morison .....	×	
<i>Thrips hawaiiensis</i> (Morgan).....	×	×**

Thrips hawaiiensis f. imitator Pr. ....	×	×	**
Thrips nigropilosus Uzel .....	×		
Thrips saccharoni Moulton .....		×	
Thrips tabaci Lind. ....	×	×	
Thrips (Isoneurothrips) australis (Bag.).....		×	**
Thrips (Isoneurothrips) multispinus Bag. ....		×	
Thrips (Isoneurothrips) sp. ....		×	**
Thrips (Isoneurothrips) sp. ....		×	**
Thrips (Microcephalothrips) abdominalis Cwfd...	×		
Plesiothrips panicus (Moulton) <sup>4</sup> .....		×	
Merothrips hawaiiensis Moulton.....		×	
<i>Tubulifera</i>			
Dermothrips hawaiiensis Bag. ....	×		
Oedemothrips laticeps Bag. ....		×	**
Hoplothrips angusticeps (Bag.) .....		×	
Hoplothrips dubius (Bag.) .....		×	
Hoplothrips flavipes (Bag.) .....	×		
Hoplothrips flavitibia Moulton .....	×	**	
Hoplothrips hawaiiensis Moulton.....	×		
Hoplothrips intermedius (Bag.) .....	×		
Hoplothrips lanaiensis (Bag.) .....		×	
Hoplothrips mauiensis Moulton .....	×		
Hoplothrips ovatus (Bag.) .....	×		
Hoplothrips swezeyi Moulton.....	×		
Macrophthalthothrips hawaiiensis Moulton.....	×		
Karnyothrips melaleuca (Bag.).....		×	
Haplothrips fusca Moulton.....		×	
Haplothrips gowdeyi (Frank.) .....	×	×	
Aleurodothrips fasciapennis (Frank.).....		×	
Phloeothrips mauiensis Moulton.....	×		

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\*\* Heretofore unrecorded species on the island.

<sup>4</sup> As Dr. J. D. Hood originally suggested in private correspondence, this species was found to fit fully the description of *P. perplexus* (Beach), but since specimens of *P. perplexus* are not now available for comparison, establishment of the synonym is withheld until such examination can be made. See Hood, Rev. de Ent. 6(2): 258, 1936.



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## Thrips From Kauai<sup>1 2</sup>

K. SAKIMURA

Pineapple Research Institute

AND

T. NISHIDA

Hawaii Agricultural Experiment Station

(Presented at the meeting of December 13, 1943)

Forty lots of thrips specimens were collected during the period from August 12 to September 15, 1943 by one of the authors (T.N.), at various localities along the drier section of the lowlands from Wailua to Kekaha and in the wet highlands of Kokee. The specimens were examined by the other author (K.S.). Collections were most concentrated at Hanapepe where almost one-half of the material was collected. The cultivated plants and nearby weeds were mainly examined, particularly to search for the presence of *Hercothrips fasciatus* (Perg.) which was recently discovered on the island of Molokai (13) and to ascertain the distribution and population status of *Frankliniella* sp., another recent immigrant species. There was no indication of the presence of the former species there, but the latter was widely distributed and very abundant. Very little of the thysanopterous fauna, especially of the introduced species in the cultivated lowlands of this island has been known; only seven species had been recorded up to 1937 when one of the authors (K.S.) (11) made the first extensive collection and added 13 species to its list. The present collection added seven more heretofore unrecorded species. A complete list of species now known from this island is given at the end of the paper.

### *Heliethrips haemorrhoidalis* Bouché

Kapaa: Hibiscus, flowers.<sup>3</sup>

Kokee: Gladiolus, leaves.

A light infestation of this thrips along with an even lighter one of *Taeniothrips simplex* was found on a few gladiolus plants growing under semi-wild conditions within the forest area. A single specimen was also collected from hibiscus. This species is apparently a forest or wetland species. Gladiolus is a new local host

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<sup>2</sup> Acknowledgment is due to Messrs. K. I. Hanson and K. Ito who collected, upon request, some of the specimens.

<sup>3</sup> Collected by Mr. K. Ito in June, 1943.

record. These are the second collections on Kauai; the first specimen was collected in 1895 by Dr. R. C. L. Perkins (1).

**Selenothrips rubrocinctus** (Giard)

Hanapepe: *Eugenia cumini* (Java plum), leaves.

*Litchi chinensis* (litchi), leaves.

Severe injuries were observed on a young Java plum where the populations were extremely high. Infestation was very low on a litchi growing in the vicinity. Litchi is a new local host record.

**Chirothrips fulvus** Moulton

Hanapepe: *Paspalum dilatatum* (dallis grass), flower sheaths.

A few specimens were collected from within the half-open flower sheaths. This is the first collection from Kauai and the host is a new record. Only three collections have been made, all from Oahu, in the past; from *Paspalum orbiculare* in 1930 (8), on wind traps in 1935 (4), and from the same host again in 1938 (12). Although the species was described from specimens collected from the Hawaiian Islands, it probably has been introduced from the mainland for its presence was recently reported from Texas (6).

**Chirothrips spiniceps** Hood

Hanapepe: *Echinochloa crusgalli* (barnyard grass), flower sheaths.

A light infestation was found within the half-open flower sheaths of the plants growing in a rice patch. This is the second collection on Kauai and the host is a new record. The Hawaiian species was described under the name of *C. sacchari* Moulton from specimens collected on Oahu in 1929 (8), but was subsequently recorded as a synonym of *C. spiniceps* (5) (6), often abundant and widely distributed in southern United States as well as along the Atlantic coast and once observed as having been abundant on sugar cane in Arizona. This species must have been introduced from the mainland.

**Scirtothrips antennatus** Moulton

Upper Kekaha: Carrot, leaves.

A single specimen was collected. This species has been known in the Hawaiian Islands since 1930 (9), and is distributed on Oahu also. *Panax* is the preferred host, but there are two other known host plants. The present one is a new record.

**Leucothrips piercei** (Morgan)

Wailua: Bush bean, leaves.

Waimea: Bush bean, leaves of seedlings.

Upper Kekaha: Carrot, leaves.

Light infestations of this species, a common thrips on various vegetables and ornamental herbs, were found at each of the localities, making this the second collection from Kauai. This species has been known in the Hawaiian Islands since 1931 when the first specimen was collected from cocklebur (*Xanthium saccharatum*) at Moanalua, Oahu. Although Mr. Dudley Moulton determined the species from the specimen mentioned above, he failed to list it in his papers of Hawaiian thrips. The known distribution is only Oahu and Kauai.

### **Dendrothripoides ipomeae** Bag.

Lihue: Sweet potato, leaves.

A light infestation causing slight injuries was observed in a large planting of sweet potato. This is the first record from Kauai. This species was only quite recently, in 1940, discovered in the Hawaiian Islands, at Kailua, Oahu (2). Although an infestation on sweet potato was first found at Ewa, Oahu in 1941, it was stated that there were no visible injuries (3). However, one of the authors (T.N.) observed severe injuries as scars and malformation at the growing terminals on sweet potato at the University farm in Manoa, Oahu in May, 1942, and moderate injuries on lettuce growing nearby. The determination of the species was made by Dr. J. D. Hood. In addition to the above records, the other author (K.S.) found a moderate infestation on yam (*Dioscorea* sp.) at Waialae, Oahu in September, 1943, and collected a single specimen from koali (*Ipomoea congesta*) at Kahaluu, Oahu in October, 1942. These records indicate that this species must be rather common and generally distributed, at least on Oahu.

### **Anaphothrips (Chaetanaphothrips) orchidii** (Moulton)

Hanapepe: *Litchi chinensis* (litchi), leaves.

A single specimen was collected. This is the first collection from Kauai and the host is a new record. This species has been known in the Hawaiian Islands since 1926 (7) but reported only from Oahu. This is a rather common thrips and has a fairly wide host range; bougainvillea flowers were recently found moderately infested at Hauula and Manoa, Oahu, and breeding was also observed on leaves of *Emilia sonchifolia* under confinement.

### **Scolothrips sexmaculatus** (Perg.)

Waimea: Bush bean, leaves of seedlings.

*Thunbergia grandiflora* (thunbergia), leaves.

A few specimens were collected on both plants on which moderate infestations of mites were found. The present collection is

the first record from Kauai. This species has been known in the Hawaiian Islands since about 1910 (1) but reported only from Oahu. Although collections have been recorded only twice in the past, a long series of unpublished data indicates that this is one of the common thrips on Oahu and that wherever plants, especially cultivated plants, are infested with mites, the thrips populations are gradually built up. Such an association of this thrips with mite was found not only in the dryland but also in wetland areas.

**Frankliniella sp.**

Kapaia: Eggplant, flowers.

Lihue: *Melaleuca leucadendron* (paper bark), flowers.

Upper Wahiawa: *Aster* sp., flowers.

Hanapepe: Hibiscus, flowers.

*Momordica balsamina* (balsam apple), flowers.

*Salvia leucantha* (a sage), flowers.

*Crotalaria mucronata* (*C. saltiana* of the Hawaiian authors)  
(rattle pod), flowers.

*Amaranthus hybridus* (spleen amaranth), flowers.

*Sesbania grandiflora* (sesban), flowers.

Canna, flowers.

*Abutilon molle* (wild abutilon), flowers.

*Erigeron albidus* (horseweed), flowers.

*Ipomoea congesta* (*I. insularis* of the Hawaiian authors)  
(koali), flowers.

Makaweli: Hibiscus, flowers.<sup>4</sup>

Waimea: Pole bean, flowers.

Eggplant, flowers.

Waimea beach: *Ipomoea pes-caprae* (beach morning glory),  
flowers.

*Tribulus cistoides* (nohu), flowers.

Kekaha: *Leucaena glauca* (koa haole), flowers.

*Prosopis chilensis* (kiawe), flowers.

Kokee: *Buddleia japonica* (summer lilac), flowers.

This is the same species mentioned in the previous papers (10) (13). In a discussion with Mr. N. L. H. Krauss, he remarked that some specimens which he thought were this species were among his Kauai thrips collection of October, 1942. This is presumed to be the first record of this thrips from Kauai. The present collection showed that this species is as widely distributed and as common and abundant there as it is on Oahu. The largest number of specimens of a single species in the whole collection was of this thrips which indicates that this is the commonest thrips in the lowland

<sup>4</sup> Collected by Mr. K. I. Hanson in September, 1943.

during the dry season. As no specimen was collected in 1937 (11), the establishment on Kauai must have been made since this date.

Through the effort of Dr. F. G. Holdaway, specimens of this species from Hawaii were recently made available for examination. They were collected from eggplant flowers at Kona in September, 1943. Now, the known distribution includes all islands of the Hawaiian group except Lanai.

Infestations were heavy on balsam apple, rattle pod, koali, hibiscus at Makaweli, pole bean, eggplant at Waimea, and beach morning glory; moderate on eggplant at Kapaia, sesban, canna, wild abutilon, nohu, and koa haole; and light on the others. However, the species was predominant on every host plant examined except paper bark, *Aster* sp., amaranth, canna, horseweed, koa haole, and summer lilac. Populations were generally high in the drier sections between Hanapepe and Kekaha, and low in the slightly wetter sections north of Lihue and at Kokee. The predominating thrips on flowers in the drier areas was the present species; but in the wetter areas, *Thrips hawaiiensis* and *T. hawaiiensis* f. *imitator*. These indications for a differential preferred habitat of these two thrips were also observed on Oahu, Maui, and Molokai (13). All host plants except eggplant, hibiscus, and nohu are new host records.

### **Taeniothrips alliorum** Pr.

Upper Kekaha: Onion, leaves.

Relatively high populations for this species were found at upper Kekaha. A wetland species, it seldom establishes high populations in the dry lowlands. This species has been known in the Hawaiian Islands since 1930 (8) and reported from all the islands except Hawaii. It probably has been introduced from the Orient, where it is especially common in Japan, Korea, Loochoo, and Formosa.

### **Taeniothrips simplex** Morison

Kokee: Gladiolus, leaves.

*Tritonia crocosmaeflora* (montbretia), flowers.

Infestations were light on gladiolus but moderate on montbretia and few typical scars were found on both plants growing under semi-wild conditions within the forest area. Gladiolus was examined for this thrips at several places on the previous trip (11) but its presence could not be found at that time. Apparently this is the first record from Kauai. The known distribution now includes all of the Hawaiian Islands except Molokai and Lanai. This species is quite a specific feeder and only very few normal, natural host plants are known in the other countries where it occurs. Montbretia

is one of these few plants and collection from it, a new local host record, is very interesting.

**Thrips hawaiiensis** (Morgan) and **T. hawaiiensis f. imitator** Pr.

Kapaa: Hibiscus, flowers.<sup>5</sup>

Upper Wailua: Bell pepper, flowers.

Wailua: Bush bean, flowers and leaves.

Lihue: *Scaevola frutescens* var. *sericea* (beach naupaka), flowers.

*McAlauca leucadendron* (paper bark), flowers.

Upper Wahiawa: *Aster* sp., flowers.

Hanapepe: Bush bean, flowers.

*Crotalaria mucronata* (rattle pod), flowers.

Canna, flowers.

*Telosma cordata* (pakalana), flowers.

Waimea: Pole bean, flowers.

Kekaha: *Leucaena glauca* (koa haole), flowers.

Kokee: *Buddleia japonica* (summer lilac), flowers.

Gladiolus, leaves.

These flower thrips were very common and abundant and collected from various hosts throughout the areas covered by the collection. Infestations were heavy on bell pepper, beach naupaka, pakalana, and summer lilac; moderate on hibiscus, bush bean at Wailua and Hanapepe, paper bark, canna, and koa haole; and light on the others. Although these species showed some preference for certain hosts, their populations were generally high in the wetter sections or under shady surroundings and were low in the drier sections between Hanapepe and Kekaha. Bell pepper, bush and pole bean, beach naupaka, paper bark, *Aster* sp., pakalana, summer lilac are new local host records. Among 152 specimens examined, there were 92 *imitator*, 55 *hawaiiensis*, and 5 others with anomalous antennae.

**Thrips tabaci** Lind.

Wailua: Bush bean, leaves.

Upper Wahiawa: *Aster* sp., flowers.

Waimea: Bush bean, leaves of seedlings.

Kekaha: *Leucaena glauca* (koa haole), flowers.

Upper Kekaha: Carrot, leaves.

Onion, leaves.

Infestations were either very light or light on bean and carrot on which *Leucothrips piercei* predominated. A moderate infesta-

<sup>5</sup> Collected by Mr. K. Ito in June, 1943.

tion along with a subincidental number of *Taeniothrips alliorum* was found on onion at upper Kekaha. Very few were collected from *Aster* sp., a new local host record, and koa haole.

### Thrips (*Isoneurothrips*) *australis* (Bag.)

Kokee: *Buddleia japonica* (summer lilac), flowers.

A single specimen was collected in the rain forest area. This is the first record from Kauai. As in Australia, the native territory of this species, there seem to be many other host plants besides *Eucalyptus*, a preferred host, in the Hawaiian Islands. Summer lilac is a new local host record.

### *Plesiothrips panicus* (Moulton)

Hanapepe: *Paspalum dilatatum* (dallis grass), flower sheaths.

A single specimen was collected from within half-open flower sheaths. This is the second collection on Kauai and the host is a new record. The earliest collection of this species, one of the very common grass thrips, in the Hawaiian Islands was made in 1928 (8) and its known distribution also includes Oahu and Molokai. This species is probably a synonym of *P. perplexus* (Beach) (13).

### *Haplothrips gowdeyi* (Frank.)

Upper Wahiawa: *Aster* sp., flowers.

Hanapepe: *Salvia leucantha* (a sage), flowers.

*Crotalaria mucronata* (rattle pod), flowers.

*Amaranthus hybridus* (spleen amaranth), flowers.

*Mimosa pudica* (sensitive plant), flowers.

Carrot, flowers.

Canna, flowers.

*Erigeron albidus* (horseweed), flowers.

*Echinochloa crusgalli* (barnyard grass), flower sheaths.

*Paspalum dilatatum* (dallis grass), flower sheaths.

Waimea beach: *Tribulus cistoides* (nohu), flowers.

Upper Kekaha: Carrot, leaves.

Kokee: *Buddleia japonica* (summer lilac), flowers.

This common and very polyphagous thrips was frequently collected from cultivated plants and weeds throughout the area covered by the present collection. Infestations were heavy only on amaranth which seems to be a preferred host; moderate on *Aster* sp., horseweed, and nohu; and light on the others. *Aster* sp., *Salvia leucantha*, spleen amaranth, sensitive plant, canna, barnyard grass, dallis grass, nohu, and summer lilac are new local host records.



## LIST OF THRIPS KNOWN FROM KAUAI

*Terebrantia*

- Heliothrips haemorrhoidalis* Bouché  
*Selenothrips rubrocinctus* (Giard)  
 \**Chirothrips fulvus* Moulton  
*Chirothrips spiniceps* Hood  
*Limothrips cerealium* Halid.  
*Scirtothrips antennatus* Moulton  
*Leucothrips piercei* (Morgan)  
 \**Dendrothripoides ipomeae* Bag.  
*Anaphothrips swezeyi* Moulton  
 \**Anaphothrips* (*Chaetanaphothrips*) *orchidii* (Moulton)  
 \**Scolothrips sexmaculatus* (Perg.)  
 \**Frankliniella* sp.  
*Taeniothrips alliorum* Pr.  
 \**Taeniothrips simplex* Morison  
*Thrips hawaiiensis* (Morgan)  
*Thrips hawaiiensis* f. *imitator* Pr.  
*Thrips saccharoni* Moulton  
*Thrips tabaci* Lind.  
 \**Thrips* (*Isoneurothrips*) *australis* (Bag.)  
*Thrips* (*Isoneurothrips*) *multispinus* Bag.  
*Thrips* (*Isoneurothrips*) spp. (3 species)<sup>6</sup>  
*Thrips* (*Microcephalothrips*) *abdominalis* Cwfd.  
*Plesiothrips panicus* (Moulton)

*Tubulifera*

- Dermothrips hawaiiensis* Bag.  
*Karnyothrips melaleuca* (Bag.)  
*Haplothrips gowdeyi* (Frank.)

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\* Heretofore unrecorded species on Kauai.

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## The Kou Moth, *Ethmia colonella* Walsm., in Hawaii

BY O. H. SWEZEY

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of February 8, 1943)

This moth is attached to the "kou" tree, *Cordia subcordata* Lamarck. It was described in the family Oecophoridae by Walsingham in the Fauna Hawaiensis, 1 (5): 507, 1907, from 19 specimens collected by Perkins in 1896 in Honolulu. Walsingham considered it the same species as the two moths collected by Blackburn prior to 1882, which were determined incorrectly by Butler as *Azinis hilarella* Walker (Ent. Mo. Mag., 19: 180, 1883). Butler quotes Blackburn as saying: "I have twice taken this insect, though at long intervals, each time it was apparently attracted by light, but seemed very sluggish, and apparently satisfied to sit and look at the light from a distance". The Perkins specimens mentioned above, were from an unrecorded cultivated plant in Honolulu, and the statement was made that it was probably an introduced species.

Since 1906, it has been known that *Cordia subcordata* was its host plant, there being specimens in the H.S.P.A. collection reared from this plant by Terry, August and December, 1906, in Honolulu. In Proc. Haw. Ent. Soc., 6 (3): 373, 1927, Swezey records finding a *Cordia subcordata* tree infested with *Ethmia* caterpillars at Kahului, Maui, October 16, 1926. Several moths were reared by Pemberton from an infested *Cordia* tree at Black Point, Honolulu, November 20, 1935. The specimens now exhibited were reared February 4, 1943 from caterpillars brought in by Dr. Lyon from a young infested *Cordia* tree in Foster Garden, Honolulu. Furthermore, it is certainly the moth whose caterpillars were referred to by Dr. Hillebrand in "Flora of the Hawaiian Islands": 321, 1888, where, under "*Cordia subcordata*", he says: "Along the seashore here and there; formerly much planted by the natives round their houses, but now almost exterminated by the ravages of a small moth. . . . It ranges all the way from the Hawaiian Islands to Madagascar and Zanzibar, and would seem to have accompanied the Malayo-Maori race in their migrations, a reason for which may be found in the large shade afforded by its broad crown, particularly valuable in a littoral tree. The wood, rather soft but durable, is much prized for cabinet work, cups and dishes, exhibiting wavy ribbons of light and dark brown when polished". It was a favorite wood with the Hawaiians for making calabashes. Since 1906, and probably since Hillebrand's time, no trees have been able to grow

large enough for this purpose. They are always kept stunted on account of the caterpillars of *Ethmia colonella* feeding on the young terminal foliage and checking the growth of the tree. In fact, the tree is so scarce that only an occasional stunted example is now seen.

The caterpillars are protected by webs. The full-grown caterpillar is about 22 mm. long; black, with the dorsal and lateral surfaces speckled with numerous small irregular-shaped light yellow spots, a median dorsal pair of closely-parallel interrupted light yellow lines, laterally the spots are assembled in a distinct broken stripe just above the line of spiracles, which are small dark and nearly circular; cervical shield black with anterior margin widely light yellow and a median light yellow line; head black; head, cervical shield and dorsum with long slender black setae. Four pairs of slender abdominal prolegs.

The white cocoons are elongate oval, made rather flat on the surface of a leaf or other object. The pupa is 10 mm. long; uniformly reddish brown, surface smooth; wing and leg cases extend to the posterior margin of the fourth abdominal segment; cremaster has two stout spines situated ventrad a little forward from the apex of the abdomen and projected forward at a 45 degree angle, having numerous slender hooks to hold to the silk of the cocoon. This feature of the pupa distinguishes it from the pupa of any other moth in Hawaii. The caterpillar, too, is distinct from any other occurring in Hawaii. The pimpline parasite *Ephialtes hawaiiensis* (Cameron) has been recorded from the pupa, according to Perkins.

In 1920, two moths were collected by Kusche at Kaholuamano, Kauai. Hence, it is known on the three islands Oahu, Maui and Kauai, and no doubt would also be found on the other islands of the Hawaiian group if the *Cordia* trees were found and examined there.

Two or three other species of *Cordia* are planted in Honolulu and other localities, but *Ethmia colonella* has not been found feeding on any of them.

All along we have speculated on where *Ethmia colonella* might have come from, as we had not learned of any records of its occurrence in other localities. Just lately in searching the literature for other species of *Ethmia* and their habitats, I found that *Ethmia praeclara* was described from Lombok by Meyrick in 1910. It is a species which differs from *colonella* in only a few minor details. In the same paper (Trans. Ent. Soc. London, 1910: 461), he describes three other species of *Ethmia* from Solomon Islands, Malay States and Queensland, respectively, which are also only slightly different from *colonella*. Nothing is given as to food plants. Could it be possible that these species are also to be found attached to

*Cordia*? Also, in this same paper, Meyrick records our *colonella* from Kei Islands. These islands are a little south of the western part of New Guinea. This seems a very unlikely place for *colonella* to migrate from to Honolulu. Perhaps we may venture the opinion that some future entomological explorations will discover it on some of the nearer intervening islands.

The family name *Ethmiadae* has been used by Busck and Meyrick for *Ethmia* and related genera. (See Journ. Bombay Nat. Hist. Soc., 19: 422, 1909, and Proc. Ent. Soc. Washington, 12: 53, 1910)

Later note: It is of interest to record that observations on the above *Cordia subcordata* tree at Foster Garden, at other times during the year, showed that there had been no recurrence of the earlier severe infestation. In September the tree had quite recovered from the early infestation and made a fine growth. Only two caterpillars were found by careful search. Four months later the tree was in fine flourishing condition, with no evidence of injury by *E. colonella* caterpillars. It will be of interest to continue observations and ascertain how long a period elapses before another severe infestation occurs on this tree, and to determine if possibly this moth has seasonal recurrences.

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### Synonymy of *Euxoa hephaestaea* (Meyrick) (Lep.)

BY O. H. SWEZEY

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of February 8, 1943)

*Agrotis hephaestaea* Meyrick, Fauna Hawaiiensis, 3: 346, 1904.

*Euxoa diplosticta* Hampson, Ann. Mag. Nat. Hist., VIII, 4: 368, 1909.

*Euxoa wikstroemiae* Swezey, Proc. Haw. Ent. Soc., 4: 377, 1920.

Meyrick described *hephaestaea* from 14 specimens collected by Perkins in N.W. Koolau range, Oahu, July, 1901. Hampson described *diplosticta* from a single male collected by Perkins at Wai-  
alua, Oahu, without date. I suspect that this specimen was one from the same lot that Meyrick worked with, for the region where Perkins collected in N.W. Koolau range was above the Wai-  
alua plantation, and it is possible that a specimen (or maybe more of them) was labelled "Wai-  
alua" as there is a specimen labelled "Wai-  
alua" in the H.S.P.A. collection which is undoubtedly from the same lot. Swezey described *wikstroemiae* from two females reared

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from caterpillars found on a *Wikstroemia* bush in the vicinity of Puu Kapele, Waimea Canyon, Kauai, Feb. 14, 1915. These two specimens agree with Hampson's description of *diplosticta* and have the two black spots which Hampson describes on each side of vein 5 near termen of forewing. These spots are not mentioned in Meyrick's description, and no doubt were not present, for in a series of specimens at the Bishop Museum, collected more recently, some have these spots while they are lacking in others.

Of the Bishop Museum series, 15 specimens were collected by Kusché in 1919 and 1920, at several localities on Kauai: Kokee, Alakai Swamp, Kaholuamano and Olokele; and one specimen was collected by Dr. C. M. Cooke, Jr. at Wailua, Kauai in 1925. This series of specimens has a gradation in color: some ferruginous like Meyrick's *hephaestaea* and others with shades of gray like Hampson's *diplosticta*, and some of these latter have the two black spots near the termen. Thus is demonstrated the synonymy of the species. Also at the Bishop Museum are three specimens from Molokai: one reared from *Wikstroemia* at Waikolu, 1925 and two taken at light at Kainalu, 1927, all by Swezey. These three are of the ferruginous type of coloration.

Furthermore, while at the U. S. National Museum in 1938, I noted 20 specimens labelled *Euxoa diplosticta* Hampson which were obtained from Mr. B. Preston Clark, who had received them from Kusché who was collecting for him on Kauai in 1919 and 1920. These specimens are not labelled, but are undoubtedly of the same lot as those from Kauai, at the Bishop Museum, mentioned above. They exhibit the same variations in color as the latter. Some of them have the two black spots near termen, and some lack them. There was also besides these a single specimen collected by Ashmead and labelled "*hephaestaea*". (I assembled all the specimens together with the latter name.)

The caterpillar is distinctly different from other known agrotid caterpillars in Hawaii. I have found them on *Wikstroemia* at various localities on Oahu: Oct. 25, 1914, on the ridge back of Alewa Heights; April 30, 1916, on Waialae-nui ridge; July 9, 1916, on Mt. Kaala; Feb. 8, 1925, at Malamalama. Success was not had in rearing these, which is often the case in bringing caterpillars from the mountain forests, on account of failure to bring enough of their food plant, or failure to keep it in fresh condition for them to feed on till maturity, or often the difficulty or inconvenience of making a special trip back for more fresh foliage.

From the above records, this moth is now known to occur on Kauai, Oahu and Molokai. No doubt it will yet be found on the other Hawaiian Islands, as its food plant, *Wikstroemia*, is known at least on Maui, Lanai and Hawaii.

Notes on *Zaischnopsis* sp., an egg-parasite of  
*Holochlora japonica* in Hawaii

BY O. H. SWEZEY

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of October 11, 1943)

This parasite of *Holochlora japonica* (Brunn.) eggs was first observed by Mr. E. M. Ehrhorn ovipositing in a cluster of *Holochlora* eggs in his garden in Manoa Valley, May 12, 1938. From these eggs, 14 female *Zaischnopsis* issued between July 1 and August 1. Eight of the parasites issued on the same day, July 27. Thus the life cycle from egg to adult was about 10 or 11 weeks.

The parasites of the new generation were supplied with a fresh egg cluster of *Holochlora*, and oviposition occurred August 3 to 6. From this, 42 adult *Zaischnopsis* issued September 20 to November 4. The most of them (33) issued September 24 to October 10. This would indicate an average life cycle of seven to nine weeks, with a maximum of 13 weeks.

From another cluster of *Holochlora* eggs brought in by Mr. Ehrhorn, 11 *Zaischnopsis* issued September 6 to November 6. From an egg cluster found in hibiscus twig by Mr. Swezey, October 22, 1939, 15 *Zaischnopsis* issued, some of them at greatly delayed intervals.

In all of above cases every specimen was a female. A female specimen was collected by Swezey, October 8, 1939, in the Waianae Mts. near Puu Hapapa, which is the only record outside of Manoa Valley where first discovered.

The first record of this insect in the Proceedings of the Hawaiian Entomological Society was under the name *Anastatus*. (10: 187, 192, 1939). Specimens were submitted to Mr. A. B. Gahan, U. S. Bureau of Entomology, who pronounced it an undoubtedly new species of *Zaischnopsis*, a genus related to *Anastatus*.



## Keys to Some Lepidopterous Larvae Found in Gardens and Homes in Hawaii\*

BY O. H. SWEZEY

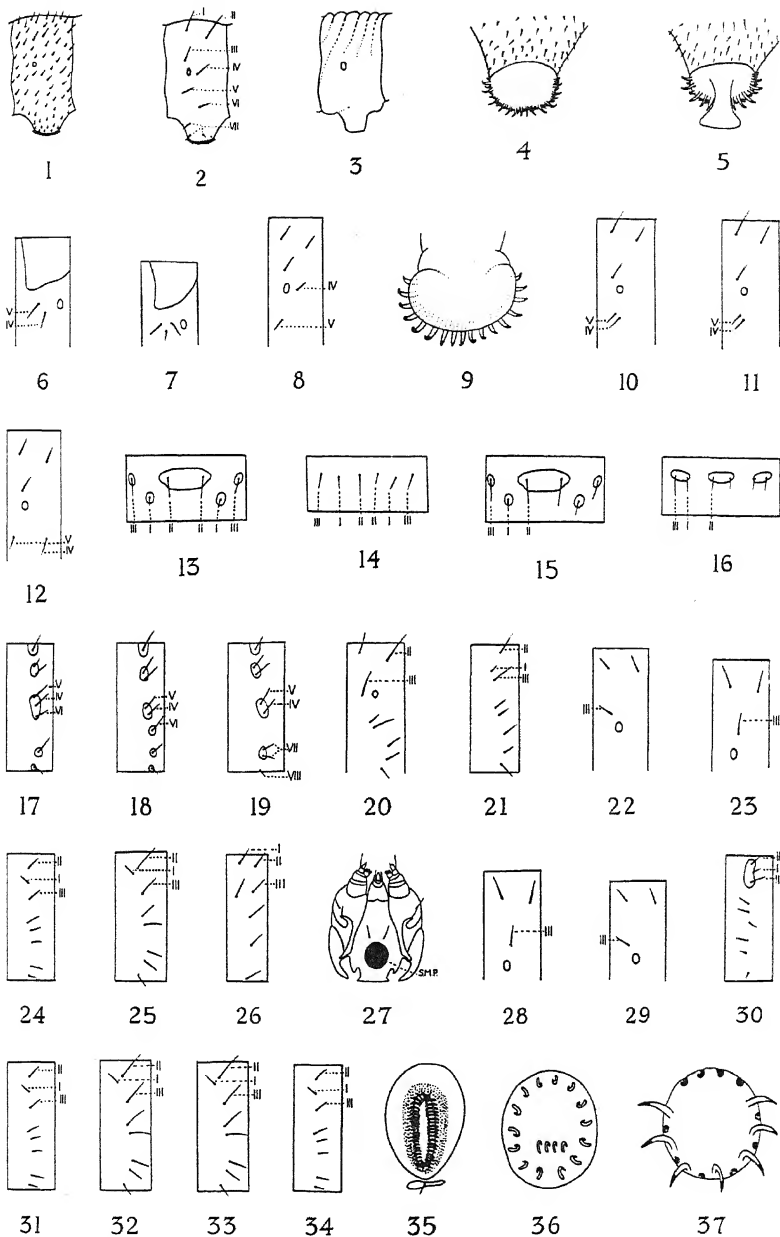
Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of August 9, 1943)

### KEY TO FAMILIES

1. Caterpillars large, more than two inches; a long pointed dorsal horn on 8th abdominal segment.....**Sphingidae**  
Caterpillars less than two inches.....2
2. A pair of long soft moveable black horns or appendages on mesothorax, a shorter pair of similar appendages on 8th abdominal segment.....**Danaidae**  
Without above appendages; body more or less hairy and with the usual setae represented by branching spines; skin minutely shagreened.....**Nymphalidae**  
Not as above.....3
3. Body with numerous short secondary setae (See fig. 1).....4  
Body without numerous short secondary setae (See fig. 2).....5
4. Body cylindrical, not depressed, segments divided into 6 or fewer annulets; crochets in a continuous mesoserries not interrupted by a spatulate lobe (See figs. 3, 4).....**Pieridae**  
Body depressed, fusiform (spindle-shaped), segments not divided into annulets; crochets in a mesoserries interrupted at center by a spatulate lobe (See fig. 5).....**Lycaenidae**
5. With more than one pair of abdominal prolegs.....6  
With abdominal prolegs absent except on 6th segment.....**Geometridae, Hydrimenidae, Selidosemidae**
6. Two setae in prespiracular group of prothorax (See fig. 6).....7  
Three setae in prespiracular group of prothorax (See fig. 7).....8
7. Proleg-bearing segments with setae IV behind, and V below the spiracle; crochets in a longitudinal mesoserries (See figs. 8, 9).....**Noctuidae**  
Proleg-bearing segments with setae IV and V close together below the spiracle; crochets in a continuous ring or a penellipse (fig. 10).....**Pyralididae**
8. Setae IV and V of proleg-bearing segments close together below the spiracle (fig. 11).....9  
Setae IV and V of proleg-bearing segments distant from each other and below the spiracle (fig. 12).....16
9. Paired setae II of 9th abdominal segment on a sclerotized plate (fig. 13).....10  
Paired setae II of 9th abdominal segment not on a sclerotized plate (fig. 14).....12

\* Adapted from keys devised by Hahn W. Capps of the Division of Insect Identification of the U. S. Bureau of Entomology and Plant Quarantine (E-475), May 1939.



Lepidopterous Larvae: Arrangement of Setae, Crochets, etc.  
(diagrammatic) [after Capps].

10. Seta I of 9th abdominal segment approximately equidistant from setae II and III (fig. 15).....**Tortricidae**  
 Seta I of 9th abdominal segment closely associated with seta III, on a single sclerotized plate (fig. 16).....11
11. Seta VI present on 9th abdominal segment (figs. 17, 18).....**(Olethreutidae) Eucosmidae**  
 Seta VI absent from 9th abdominal segment (fig. 19).....**Phalonidae**
12. Seta III of 8th abdominal segment directly in front of spiracle; seta I of 9th abdominal segment approximate to seta III but not on same plate (figs. 20, 21).....**Cosmopterygidae**  
 Seta III of 8th abdominal segment not directly in front of spiracle; seta I of 9th abdominal segment not closely associated with seta III (figs. 22, 23, 24, 25, 26).....13
13. Submentum with a large oval pit; seta III of 8th abdominal segment above and slightly behind the spiracle (figs. 27, 28).....**Blastobasidae**  
 Submentum without an oval pit; or, if pit is present, seta III of 8th abdominal segment is above and in front of spiracle (fig. 29) .....14
14. Setae I, II and III of 9th abdominal segment on a sclerotized plate (fig. 30).....**Hyponomeutidae (part) (Argyresthia)**  
 Setae I, II and III of 9th abdominal segment not on a sclerotized plate (figs. 31, 32).....15
15. Seta I closely associated with II on 9th abdominal segment (fig. 33).....**Oecophoridae (part) (Endrosis and Hofmannophila)**  
 Seta I of 9th abdominal segment not closely associated with seta II, approximately equidistant from setae II and III (fig. 34).....**Gelechiidae**
16. Crochets of abdominal proleg in multiserial rings (fig. 35).....**Tineidae (part) (Acrolophus)**  
 Crochets of abdominal proleg in a complete ring, enclosing a short longitudinal series, or in a pseudocircle (figs. 36, 37).....**Hyponomeutidae (part) (Acrolepia and Plutella)**

#### DANAIDAE

Body with scattered minute short secondary setae; skin with numerous minute flattened granules; body banded segmentally with black, white and yellow rings; spiracles black, situated in the black rings. Caterpillars on milkweeds: *Asclepias*, *Gomphocarpus* and *Calotropis*. Monarch butterfly.....**Danaus plexippus** (Linn.)

#### NYMPHALIDAE

Two round white spots dorsally on abdominal segments 2-8; sparsely hairy. Caterpillar on *Gnaphalium*. Hunter's butterfly.....**Vanessa virginensis** Drury

Without the above dorsal white spots; more hairy, hairs white. Caterpillar on thistle, *Malva*, burdock and hollyhock. Thistle butterfly, or painted lady.....**Vanessa cardui** (Linn.)

## PIERIDAE

Body light green, with a yellow middorsal stripe; proleg-bearing segments with yellowish or whitish pigmented longitudinal band, discontinuous shortly posterior to the spiracle; larger seta-bearing tubercles of abdominal segments higher than their width at base. Caterpillars on cabbages and related plants; also on *Nasturtium* and *Capparis sandwichiana*. Cabbage butterfly.....*Pieris rapae* (Linn.)

## LYCAENIDAE

1. Body densely covered with short, fine setae.....2  
Setae of body fewer, larger, and of uneven size, some being longer.  
Feeds on lantana flowers.....*Thecla agra* Hewitson
2. Spiracles circular, black, conspicuous. Feeds mostly on lantana flowers, but has also been found on eggplant, berries of *Solanum nigrum* and fruit of *Cordia sebestena*.....*Thecla echion* (Linn.)  
Spiracles pale, inconspicuous. Feeds in flowers and pods of pigeon pea, *Crotalaria*, and several kinds of beans.....  
.....*Cosmolyce boetica* (Linn.)

## SPHINGIDAE

Body yellowish, with large black segmental spots on dorsum tending to form transverse bands; usually a distinct middorsal longitudinal yellow line or stripe; prothoracic shield brownish yellow, with numerous white dots. Caterpillars feed especially on *Portulaca lutea*, also on *Boerhaavia diffusa*, *Fuchsia* and *Godetia*.....  
.....*Celerio lineata* (Fabr.)

Body green, which is sometimes obscured by fuscous markings or mottling; spiracles situated in circular dark spots; an oblique dark streak above each spiracle, slanting backward, and sometimes a conspicuous longitudinal dark streak connecting the oblique streaks on dorsum, and middorsal pale streak; prothoracic shield concolorous. Caterpillars feed on morning-glory and sweet potato vines.  
.....*Herse cingulata* (Fabr.)

Body varying from yellowish green to dull greenish fuscous, sometimes pinkish; numerous pale specks in transverse lines on dorsum; spiracles oval, dark, surrounded by a narrow pale ring; above each abdominal spiracle a pale streak extending obliquely backwards; two vertical nearly parallel black streaks on front of head; prothoracic shield brownish or black; caudal horn black, curved. Caterpillars feed on tobacco, tomato, and more particularly on *Nicotiana glauca*.....*Protoparce quinquemaculata blackburni* (Butler)

## AGROTIDAE

1. Prolegs absent on abdominal segments 3 and 4, present on segments 5 and 6.....2  
Prolegs present on abdominal segments 3 to 6.....3
2. A wide whitish longitudinal stripe on each side of the dorsal vessel and including setae I and II, or sometimes separated into three crinkly white lines; a conspicuous longitudinal white line just above spiracles and occupying nearly all of the space between

- the spiracles and setae III. About 30 to 40 mm. in length.  
Feeds on nearly every kind of garden plant and weeds.....*Plusia chalcites* (Esper)
- The dorsal longitudinal white lines not so conspicuous; the longitudinal white line above the spiracles occupying only one-third to one-half of the space between the spiracles and setae III. About 25 to 30 mm. in length. Feeds on cabbage and other cruciferous plants. It has been recorded on lettuce also.  
.....*Autographa brassicae* (Riley)
3. A yellowish middorsal spot on metathorax and on abdominal segments 1 to 4....Variegated cutworm, *Lycophotia margaritosa* (Haw.)  
Without the above spots.....4
4. Skin with numerous short, sharp spines.....  
.....Corn earworm, *Heliothis armigera* (Hübner)  
Skin with numerous minute irregular-shaped sclerotized plates, or granulose.....Greasy cutworm, *Agrotis ypsilon* (Rott.)  
Skin without the above structures.....5
5. Surface covered with numerous small white irregular spots and scrawly lines; usually longitudinally darker striped.....6  
Surface without the above white spotting.....7
6. Color varying from green to nearly black; spiracles black, at the lower margin of a dark longitudinal stripe; a conspicuous white spot behind spiracle and a little higher; two dorsal longitudinal dark stripes separated by a narrower pale middorsal stripe....Nutgrass armyworm, *Laphygma exempta* (Walker)  
Color varying from green to nearly black; spiracles pale with black rim, at the lower margin of a broad dark longitudinal stripe; a conspicuous small white spot behind spiracle and a little higher; dorsal area pale with a median darker narrow longitudinal stripe which is traversed by middorsal broken pale line.....Beet armyworm, *Laphygma exigua* (Hübner)
7. Lobes of head pale testaceous with brown meshes; wide dorsal area pale with a mottling of light brown and some fuscous, and a middorsal longitudinal white line, the outer margins bordered with a white line; also white lines bordering the outer margins of the dorsal area; spiracles black, at the lower margin of a longitudinal fuscous stripe which is somewhat interrupted segmentally....Common armyworm, *Cirphis unipuncta* (Haw.)  
Head dark brown in front, paler on vertex and laterally; body dark with a velvety appearance; two dorso-lateral darker spots on abdominal segments 6 and 7; spiracles black.....  
.....*Elydna nonagrica* (Walker)

## PYRALIDIDAE

1. Seta IIB of mesothorax with a dark sclerotized ring at base.....2  
Seta IIB of mesothorax without above ring.....4
2. Setae I and II of abdominal segments with strongly sclerotized and moderately large plates at base. Feeds in *Ceratonia* pods, also *Acacia farnesiana* and pigeon pea.....*Myelois ceratoniae* Zeller  
Setae I and II of abdominal segments with definite small pigmented plates at base, not in white circles.....3  
Setae I and II of abdominal segments with definite small pigmented plates at base and situated in white circles; upper surface

- more or less fuscous. Feeds in corn silks, sorghum heads, and as a scavenger on cane leaves where there has been an infestation of aphids.....**Cryptoblabes aliena** Swezey
3. Seta IV of 8th abdominal segment separated from spiracle by about one diameter of spiracle; caterpillar smaller, about 13 mm. and about 1.5 mm. in width. Feeds in cereals and dried fruits, and in stored feed products.....**Ephestia cautella** (Walker)  
 Seta IV of 8th abdominal segment separated from spiracle by about 2 or 3 diameters of spiracle; caterpillar larger, about 16 mm. and 2 mm. in width. The Mediterranean flour moth. Often found in imported nuts.....**Ephestia sericaria** (Scott)
4. Meso- and metathorax each with a pair of sclerotized plates (without setae) on posterior dorsal margin. Feeds on seeds in lima bean pods, and some other beans also.....**Maruca testulalis** (Geyer)  
 Metathorax without the above plates; setae of abdominal segments situated in large brown sclerotized plates. Borer in sweet potato vines and tubers.....**Omphisa anastamosalis** (Guen.)  
 Meso- and metathorax without the above plates.....5
5. Ocellus I distinctly larger than ocellus II; head blackish or fuscous, with a distinct whitish area along adfrontal suture, extending to vertex. Body with pinkish longitudinal stripes. Feeds on cabbage and some other cruciferous plants.....**Hellula undalis** (Fabr.)  
 Sclerotized plates at base of setae I and II of abdominal segments not pigmented, except a few of them on margins; prothoracic shield with two black marks laterally, the posterior one larger. Feeds on beet and amaranth leaves.....**Hymenia recurvalis** (Fabr.)  
 Sclerotized plates at base of setae I and II of abdominal segments not pigmented; head light brown; prothoracic shield testaceous, unmarked. In stored foods: cereals, nuts, dried fruit, etc.....**Plodia interpunctella** (Hübner.)

## GELECHIIDAE

1. Abdominal prolegs rudimentary; each proleg usually with not more than 3 or 4 crochets.....  
 .....Angoumois grain moth, **Sitotroga cerealella** (Oliv.)  
 Abdominal prolegs normal; each proleg with more than 3 or 4 crochets .....2
2. Setae on prespiracular shield of prothorax triangularly arranged, shield not encircling the spiracle; crochets of anal legs uniordinal or biordinal, not interrupted at center; anal fork absent....3  
 Setae on prespiracular shield of prothorax in longitudinal line on the shield, which is elongate, the posterior end lying below and not connected with it.....5
3. Setae  $Adf_1$  and  $Adf_2$  of head close together, decidedly anterior to apex of front;  $P_1$  but slightly above level of  $Adf_1$  and with  $P_2$  laterad of  $P_1$ .....4  
 Setae  $Adf_1$  and  $Adf_2$  not closely associated, anterior to apex of front; seta  $P_2$  posterior to  $P_1$ ; prothoracic shield light brown, with a pale reniform spot posterior to seta  $Ib$ ; seta III of 8th abdominal segment above and in front of spiracle; crochets of abdominal prolegs uniordinal and arranged in a penellipse; skin smooth.....Pink bollworm, **Pectinophora gossypiella** (Saunders)

4. Prothoracic shield pale, whitish, with dark fuscous shading along lateral and posterior margins..... Tomato pinworm, *Keiferia lycopersicella* (Busck)  
 Prothoracic shield entirely dark brown or blackish..... Potato tuber moth, *Gnorimoschema operculella* (Zeller)
5. Prothoracic shield yellowish brown; setae I and II of abdominal segments situated in a minute dark ring; seta III in a larger conspicuous dark ring situated just above spiracle; spiracle minute, pale with a dark rim. Caterpillar with a slight pinkish tinge when alive. About 15 mm. in length. In dead plant tissues: stems of castor oil plant, lantana, fibrous matter at base of palm leaves, stems of old capsules of *Ipomoea tuberosa*, etc. .... *Autosticha pelodes* (Meyrick)
- Prothoracic shield dark brown to fuscous. Whole caterpillar dark with velvety appearance when alive. Seta III just above spiracle, not in a conspicuous dark ring as above. About 16 mm. in length. In decaying leaves, etc., on ground beneath pigeon peas, beans, etc., also in the decaying leaves, etc., of turf..... *Stoeberhinus testaceus* Butler

#### PLUTELLIDAE

- Plate at base of seta III enclosing abdominal spiracle; all setae situated in conspicuous black pigmented plates; crotchets in a complete circle. Larvae in onion leaves..... *Acrolepia assectella* (Zeller)
- Plate at base of seta III not enclosing abdominal spiracle; setae not in conspicuous pigmented plates; abdominal prolegs long and slender, crotchets in a pseudocircle. Larvae on cabbages and other cruciferous plants..... *Plutella maculipennis* (Curtis)

#### COSMOPTERYGIDAE

- Seta IIa of prothorax above level of seta Ia; crochets of abdominal proleg uniordinal, in a complete ring..... *Pyroderces* spp.
- Body slightly pinkish on dorsum; head light brown; prothoracic shield dark brown; all body setae situated in pigmented sclerotized plates; seta III of 8th abdominal segment directly in front of spiracle; on other segments III is above spiracle; IV and V together in same sclerotized plate below spiracle; paired setae II of 9th abdominal segment on a transverse sclerotized plate. Caterpillars occur abundantly in the male inflorescence of *Pandanus*..... *Pyroderces incertulella* (Walker)
- Body pink; head testaceous; prothoracic shield black; setae as above, except that the sclerotized plates are pale, and setae II of 9th segment are not together in the same plate. Caterpillars common in cotton bolls, corn silk and tassels, old pods of *Acacia farnesiana* and other legumes..... *Pyroderces rileyi* (Walsingham)

#### TORTRICIDAE

- Prothoracic shield with black lateral margin. Leafroller on many kinds of garden plants and weeds..... *Amorbia emigratella* Busck
- Prothoracic shield without black lateral margin. Leafroller on many kinds of garden plants and weeds..... *Archips postvittanus* (Walker)







## Heteroptera of Canton Island

BY ROBERT L. USINGER

University of California

(Presented at the meeting of November 8, 1943)

While visiting Honolulu in 1943 opportunity was afforded to study the undetermined Miridae of Canton Island. Other Heteroptera of Canton Island were listed by R. H. Van Zwaluwenburg (Proc. Haw. Ent. Soc. 11:306, 1943) as follows: *Geotomus pygmaeus* Dallas, *Nabis capsiformis* Germ. and *Halobates micans* Esch.

The Miridae were represented in the above list by a single damaged specimen of an "Undet. species" taken by Langford in April, 1940. This specimen proves to be the bean mirid, *Pycnoderes quadrimaculatus* Guerin, and quite possibly was brought to Canton Island from Hawaii in a collecting bottle, since no additional specimens have turned up in subsequent collections. Two specimens of

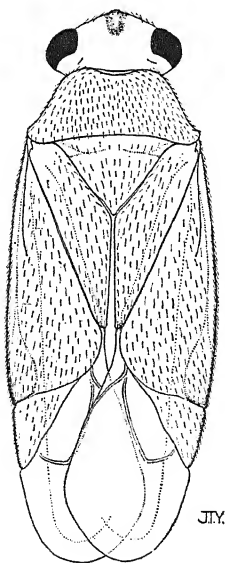


Fig. 1. *Cyrtorhinus zwaluwenburgi* Usinger. Holotype male (appendages omitted), Canton Is. (Drawn by J. T. Yamamoto).

the nearly cosmopolitan, grass inhabiting *Trigonotylus brevipes* Jakowlef were collected on Canton Island by R. H. Van Zwaluwenburg in August, 1940. Finally, three specimens of a new species of *Cyrtorhinus* are represented in the collection. This genus is widespread in the Pacific (Usinger, Proc. Haw. Ent. Soc., 10:271, 1939), the various species being predaceous on eggs of Delphacidae. Since delphacids have not been reported from Canton Island and since both *Cyrtorhinus* and the cicadellid, *Nesaloha cantonis* Oman were collected on *Boerhaavia*, it is possible that this new mirid is a predator on *Nesaloha*. It is a pleasure to dedicate this new species to R. H. Van Zwaluwenburg, who has contributed so largely to our knowledge of the insect fauna of Canton Island.

### *Cyrtorhinus zwaluwenburgi* Usinger, new species

Small, suboval, and entirely pale yellowish testaceous except for dark brown eyes and a vague brown area at middle of head. (Fig. 1.)

Head half again as broad as long, 11.5:8, smooth, shining, and strongly convex above. Eyes slightly less than half as wide as interocular space, 2.75:6. First antennal segment shorter than interocular space, 5:6, second segment three times as long as first, third and fourth segments broken off. Rostrum reaching nearly to apices of middle coxae.

Pronotum somewhat duller than head, clothed with short, sparse, decumbent hairs; broader across humeri than width of head, 15:11½, and less than half as long as broad, 6½:15; front margin shallowly concave, lateral margins feebly sinuate, and hind margin slightly concave.

Scutellum longer than pronotum at middle, 7:6, subdepressed, the disk very sparsely clothed with appressed hairs.

Hemelytra simple, distinctly but sparsely clothed with appressed hairs; costal margins slightly, evenly arcuate.

Legs slender, clothed with short, inconspicuous, pale hairs. Claws with simple hair-like setae rather than arolia.

Length, 2.35 mm., width across hemelytra .85 mm.

Holotype, male, Hawaiian Sugar Planters' Experiment Station, and one male paratype, Canton Island, November 20, 1940 (R. R. Danner). A teneral specimen is also at hand. It was swept from *Boerhaavia* on October 5, 1940, by R. R. Danner.

This species is very close to *riveti* Cheeseman in size and structure but is strikingly different from *riveti* and all other described *Cyrtorhinus* in color pattern. It will run to *riveti* in my key (*loc. cit.*) but *riveti* has a shorter second antennal segment (less than three times as long as first, 12:5), a longer rostrum which surpasses apices of middle coxae, and is entirely black with a white spot on either side of the vertex adjacent to the eyes, white at the extreme base and apex of first antennal segment, and pallid but faintly infuscated hemelytra. Like *riveti* and *mundulus*, *zwaluwenburgi* lacks distinct, convergent arolia which are characteristic of *lividipennis*, *fulvus*, and most of the great subfamily Orthotylinae.

**BIOLOGICAL STUDIES IN HAWAIIAN  
WATER-LOVING INSECTS****PART III****DIPTERA OR FLIES  
D. CULICIDAE, CHIRONOMIDAE AND  
CERATOPOGONIDAE**

BY FRANCIS X. WILLIAMS  
Experiment Station, H.S.P.A.

(Presented at the meeting December 13, 1943)

**FAMILY CULICIDAE (The Mosquitoes)**

It is probable that man has given more attention to the mosquito than to any other insect. The reason for this is obvious. Mosquitoes generally bite man, they are almost worldwide in distribution, and to that extent are a pest. They are frequently transmitters of disease and may be well adapted to man's habitat; there are day mosquitoes as well as those addicted to a night life. And while all mosquitoes require water for the development of their early stages, there are species suited to almost every type of water—pure fresh water, befouled fresh water, brackish water and water saltier even than the sea itself.

For all our knowledge of these noxious insects there still remains a very great deal to be learned about them. The life-history of many species, particularly in the tropics, is not known or but incompletely so, while it is a common belief that mosquitoes breed in tall grass or luxuriant herbage. Then again, the relatively much larger as well as quite harmless crane-flies (Tipulidae) often pass for mosquitoes of record size.

A typical mosquito has a slender piercing beak or proboscis, and the body, legs and wings are largely clothed with scales. The males have great plumose antennae—a character however, common to many other kinds of nematocerous flies. The hum of the mosquito is characteristic.

There are but three species of mosquitoes found in the Hawaiian Islands; two that are active in the daytime and one that is active at night; and while this is quite enough, our far-flung archipelago has fewer species of mosquitoes than many other Pacific islands; Samoa for example with 7 species, Fiji with 17 and Guam with 6.

Only the female mosquito bites, the male having mouth-parts not fitted for piercing the skin, feeds on nectar and plant juices. Not all species of mosquitoes are harmful; the genus *Megarhinus* for example, composed of large handsome species that as adults are plant feeders, are carnivorous in the larval stages, devouring the

young of other mosquitoes that live in tree holes, the butts of bamboos, rain barrels, etc. An attempt was made to establish a New Britain *Megarhinus* in the Hawaiian Islands, and although a considerable number of the mosquitoes were successfully introduced, conditions were not suitable for its maintenance at large; in the more tropical Fiji Islands however, a Javanese *Megarhinus* was introduced and successfully established. Mosquitoes of the genera *Psorophora* and *Mucicus* as larvae, devour the young of other mosquitoes but in the adult stage are vicious biters.

Much according to group, mosquitoes lay their eggs singly, in groups, or as "rafts". They are deposited on or near the water, and some kinds can endure prolonged draughts. The larva has four instars or stages of growth. It feeds by means of its mouth brushes that when in motion produce a current that brings small particles of food towards the mouth, or by nibbling algae, dead plant tissue, etc. with its well-formed mandibles. The posterior or respiratory end of the larva terminates in the siphon which connects with the tracheal or oxegenating system, and the anal gills the chief function of which is to absorb water (Wigglesworth, V. B.; The Function of the Anal Gills of the Mosquito Larva. Jour. Exper. Biol., 10: 16-26, 1933). In *Anopheles* the anal siphon is so short as to be practically wanting, while in *Taeniorhynchus* it is sharply pointed for piercing the tissues of aquatic plants and from which oxygen is thus obtained. Mosquito larvae are adept swimmers, outstripping the larvae of any other aquatic flies known to me.

At the last moult the fourth instar larva is succeeded by the pupa. This humped and also active stage is likewise quite familiar to the casual observer. The pupa breathes by means of a pair of respiratory trumpets situated on the back of the thorax. It swims by vigorous strokes of the abdomen which terminates in a pair of broad paddles. When the time for the eclosion of the adult is at hand, the dorsum of the thoracic integument splits and the teneral adult works its way out, clings to the floating pupal shell for a while and finally takes wing.

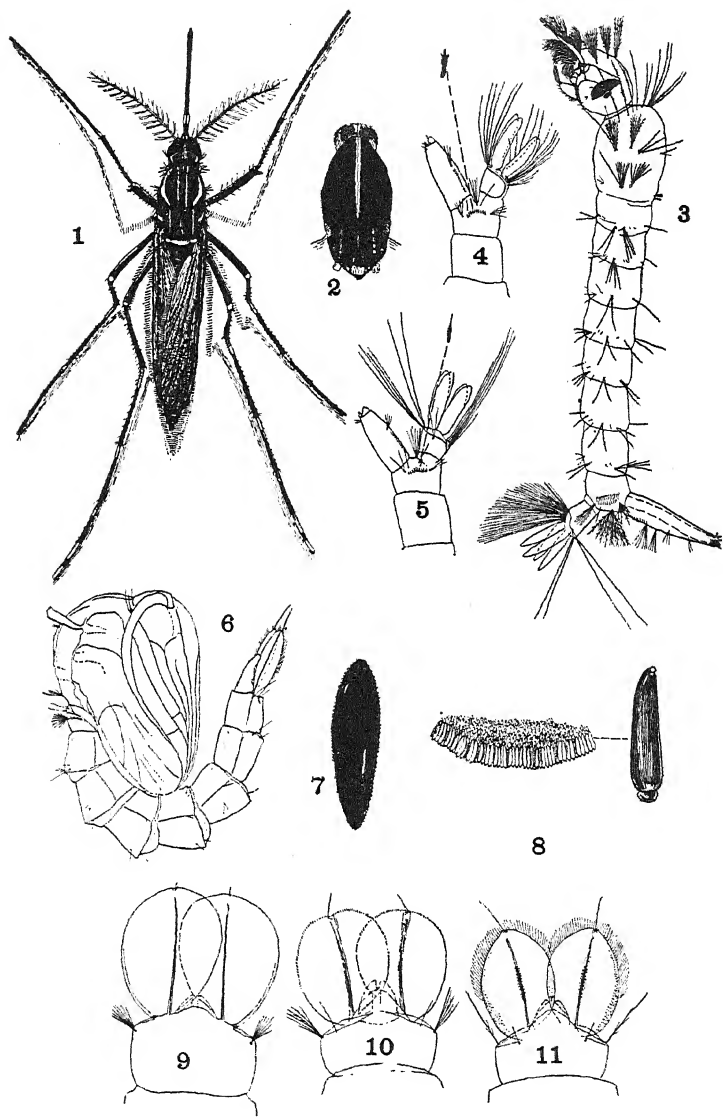
As with other nematoceros flies the male mosquito has a

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## MOSQUITOES

### EXPLANATION OF PLATE III

1. *Aedes aegypti*, female. Length 6.5 mm. Oahu.
2. *Aedes albopictus*, female, thorax, from above. Oahu.
3. *Culex quinquefasciatus*, larva, last stage. Length about 7 mm.
4. *Aedes aegypti*, larva, last stage, caudal end.
5. *Aedes albopictus*, larva, last stage, caudal end.
6. *Aedes albopictus*, pupa.
7. *Aedes albopictus*, egg. Bronzy black with fine white reticulations.
8. *Culex quinquefasciatus*, egg raft.
9. *Culex quinquefasciatus*, pupa, swimming paddles.
10. *Aedes aegypti*, pupa, swimming paddles.
11. *Aedes albopictus*, pupa, swimming paddles.



swarming habit. We sometimes see, or hear such swarms—of a very high pitch—in the darker part of an open room, or outside by the trunk of some tree or other large plant growth. Females fly into such swarms and mating then takes place.

The statement that the female mosquito first requires a meal of blood in order to deposit viable eggs may be generally true, but exceptions have been found. As regards *Culex pipiens* Linn., to quote Riley and Johannsen (Medical Entomology, : 216, 1938): "De Boissezon (1929) likewise found that this species would oviposit if fed with apple juice alone, and both he and Huff reared larvae from eggs deposited by females which had had no food whatever subsequent to the larval stage."

Mosquitoes have many natural enemies, but inasmuch as they so often get into the breeding places first, transform so rapidly and in such numbers, they gain the advantage over such predators as the larvae of dragonflies, of certain carnivorous flies, water beetles and bugs. Bugs like the slender marsh-treader (*Hydrometra*) often spear wrigglers with their beaks, and our little *Mesovelia* and *Microvelia* bugs would probably attack emerging mosquitoes. Certain predaceous flies, i.e. among the Dolichopodidae and Anthomyiidae are mosquito enemies. In the Anthomyiidae, for example, Dr. W. A. Lamborn (Bull. Ent. Res., 11: 279-281, 1920) noted a species of *Lispa* fly preying upon mosquito larvae and emerging and crippled adults in a pool near Kotakota, Lake Nyassa, Africa, and: "In the Federated Malay States Dr. Lamborn (1921) saw a species of *Lispa* carrying on their useful work in such numbers that he attributed the entire absence of *Anopheles* larvae from certain pools and ponds partly to their agency". (Evans, A. M. E., Trans. Ent. Soc. London, 78: 325, 1930). P. Tate (Parasitology, 27: 556-560, 1935; Cambridge) found the larva of the anthomyiid fly *Phaonia mirabilis* Ringdahl to be predatory on mosquito larvae at Cambridge, England. It bred in the water found in tree holes. The *Phaonia* larvae were very voracious and killed many more mosquito larvae than they would eat.

However, by far the most efficient enemies of mosquitoes in waters accessible to fish, are the little top minnows or killifish, long ago imported into Hawaii and many other countries for mosquito control.

The artificial control of mosquitoes is effected by applying the proper methods, by cooperative effort and concentrating first of all on the elimination of the breeding places.

***Culex quinquefasciatus* Say.** (plate figures 3, 8 and 9).

Say, T., Journ. Acad. Nat. Sci. Phil., 3: 10, 1823.

(= *Culex fatigans* Wiedemann, 1828).

This is the common widely distributed night mosquito. It has been with us for well over a hundred years, having arrived here

presumably from San Blas, Mexico, in the ships' supply of water. It has a brownish thorax, the legs are nearly concolorous and the abdomen pale banded. It may occur wherever there is standing fresh water, and it has been seen in temporary ponds, puddles, pools befouled with decaying guava fruit and other organic matter. It breeds also in rain barrels, water troughs and other water containers. The eggs are deposited to the number of several hundred in the form of a raft that floats lightly upon the surface of the water. They hatch in a day or two, the wrigglers descending directly into the water from a rupture made in the thicker lower end of the egg shell. The larval or wriggler stage lasts from 10 to 14 days approximately, while the pupal stage is about 2 days, so that the entire life-cycle may not exceed two weeks.

The anal siphon of the larva of this *Culex* is much longer than in our two day mosquitoes.

*Culex quinquefasciatus* is sometimes wind-borne well into the mountains and elsewhere, and it is chiefly this species that may take shelter in our automobiles in garages.

***Aedes aegypti* (Linn.).** (plate figures 1, 4 and 10).

Linnaeus, C., Hasselquist's Reise nach Palestina: 470, 1782. (*Culex*).

This is the yellow fever mosquito and also a carrier of dengue fever. It is less common here than *Aedes albopictus* and distinguished from it chiefly by the lyre-like markings on the dorsum of the thorax in contrast to the conspicuous median stripe of *albopictus*. The larva of *aegypti* has the "comb" on the siphon-bearing segment consisting of tridentate bristles, whereas in *albopictus* the bristles of the comb are simply sharp points arising from a wider basal portion (compare figs. 4 and 5).

***Aedes albopictus* (Skuse).** (plate figures 2, 5, 6, 7 and 11).

Skuse, Indian Museum Notes, 3: 20, 1895 (*Culex*).

This is the commoner of the two day mosquitoes and the less domiciliary one, as it very often breeds in our mountains, where I have seen its larvae and pupae in numbers in the rot hole in the bole of a large kukui tree (*Aleurites moluccana* [L.]). In and about the city its early stages may be passed in tree cavities containing water, in the water at the leaf bases of such plants as *Bilbergia*, *Crinum*, *Alocasia* and *Pandanus*, as well as in such water-containing receptacles as barrels, buckets and the saucers for flower pots.

*Aedes albopictus* is considered less effective in the transmission of dengue fever than is *Aedes aegypti*.

*Aedes albopictus*, commonly regarded as an Oriental species has sometimes been confused with the Australasian *Aedes scutellaris* (Walker) that occurs in the Pacific as far east as Fiji. For distinc-



tions between these two species see Edwards, Bull. Ent. Research, 7: 209-210, fig. 5, 1917; and l.c., 14: 370-371, 1924.

### FAMILY CHIRONOMIDAE (The Non-biting Midges)

The members of this family range in size from minute flies to those equalling large mosquitoes. They are separable from the Ceratopogonidae, with which they were formerly associated, by a number of characters, among which are: wings lying rooflike over the back instead of flat over the back, as with the Ceratopogonidae, and the presence in the Chironomidae of a median groove in the metanotum. Finally, the Chironomidae usually are not as thickset as the Ceratopogonidae, and there are also distinguishing characters in the immature stages.

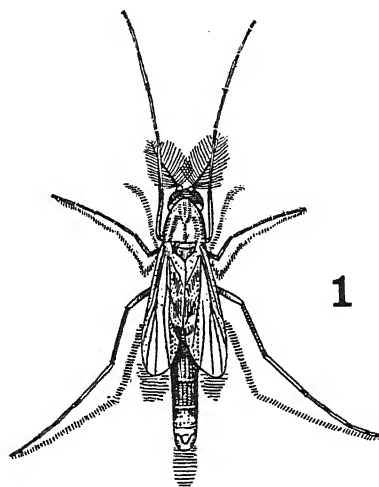


Fig. 1. *Chironomus hawaiiensis*, male. About the size of a mosquito.

In his review of the Hawaiian diptera, with descriptions of new species (Proc. Hawaiian Ent. Soc., 8, 1934) on page 446, E. H. Bryan, Jr. records 7 species of Chironomidae. Further collecting by me, together with the discovery of 2 new species of *Telmatogton* in the collection of the H.S.P.A. Experiment Station, has brought the total to at least 17 species. Inasmuch as 7 of these 10 additional species were taken on the Island of Oahu, it is very probable that many other species in this difficult group exist in our Territory.

I have derived much help in this work from the fine memoirs of the Cornell University Agricultural Station, on Aquatic Diptera, 1937—Mem. 205, part 3, by O. A. Johannsen; Mem. 210, part 4, by the same author, and part 5 (Ceratopogonidae) by Lillian C. Thomsen. Other indispensable works are those of F. W. Edwards

on the British biting midges (Ceratopogonidae) and the British non-biting midges, in the Trans. Ent. Soc. London, for 1926 and 1929, respectively, and J. R. Malloch's "Chironomidae or midges of Illinois"; Bull. Ill. State Lab. 10 (6), 1915. In addition, there are many more special papers that should be consulted.

Edwards (Trans. Ent. Soc. London 27: 286, 1929) divides the Chironomidae into five subfamilies, of which three are represented in the Hawaiian Islands. These are the Chironominae, the Orthocladiinae and the Clunioninae, the last division including our marine species.

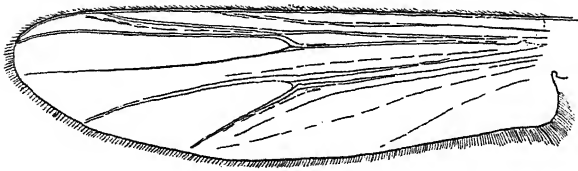
#### SUBFAMILY CHIRONOMINAE

Here belong the genera *Chironomus* and *Tanytarsus*, probably our most aquatic midges. Both are large genera in many other parts of the world, but in Hawaii only two species of *Chironomus* and one of *Tanytarsus* have been recognized. Both of these genera play a very important part in the economy of nature and are often the chief food of certain fish. As a rule, they are of little annoyance to man; their large swarms may rarely cause some inconvenience, while the bloodworm larvae of *Chironomus* sometimes breed in water tanks, whence they may be carried in tapwater to the wash bowl. *Tanytarsus* also, may gain entrance into similar tanks and other receptacles.

***Chironomus hawaiiensis*** Grimshaw. (plate IV and text figures 1, 2 and 3).

Grimshaw, P. H., Fauna Hawaiiensis, 3 (1): Diptera: 4, 5, 1901, ♂ and ♀, Oahu, Waialua, Koolau range; Feb. 1893. pl. I, figs. 6 and 7.

Of this chiefly dull greenish brown, mosquito-size insect Dr. R. C. L. Perkins says (Fauna Hawaiiensis, 1, Introduction): "*Chironomus Hawaiiensis* is one of the commonest of insects, especially near the coast or on the lowlands. Its status as a native insect is very doubtful. Being freely attracted to light, it often swarms in the verandah of houses, and forms a considerable part of the food of some of the lizards that haunt the same situation." It breeds—at first opportunity—in static or slowly flowing water, patronizing reservoirs, ponds ditches, overflows, taro and rice fields, untidy street gutters in wet districts, etc. In newly filled reservoirs, as yet unstocked with fish, it may occur in almost incredible numbers—first as elastic, nearly transparent jelly-like cylinders in which the eggs are imbedded and that wave gently at the water level from herbage, rocks or banks; then as freely-swimming, almost colorless young larvae; then as larger blood-red larvae undulating in or reaching from tubular retreats, or at large; and at last as active pupae. Under severe competition, so often its lot, *Chironomus* manages to exist among dense aquatic vegetation, such as blankets of algae.

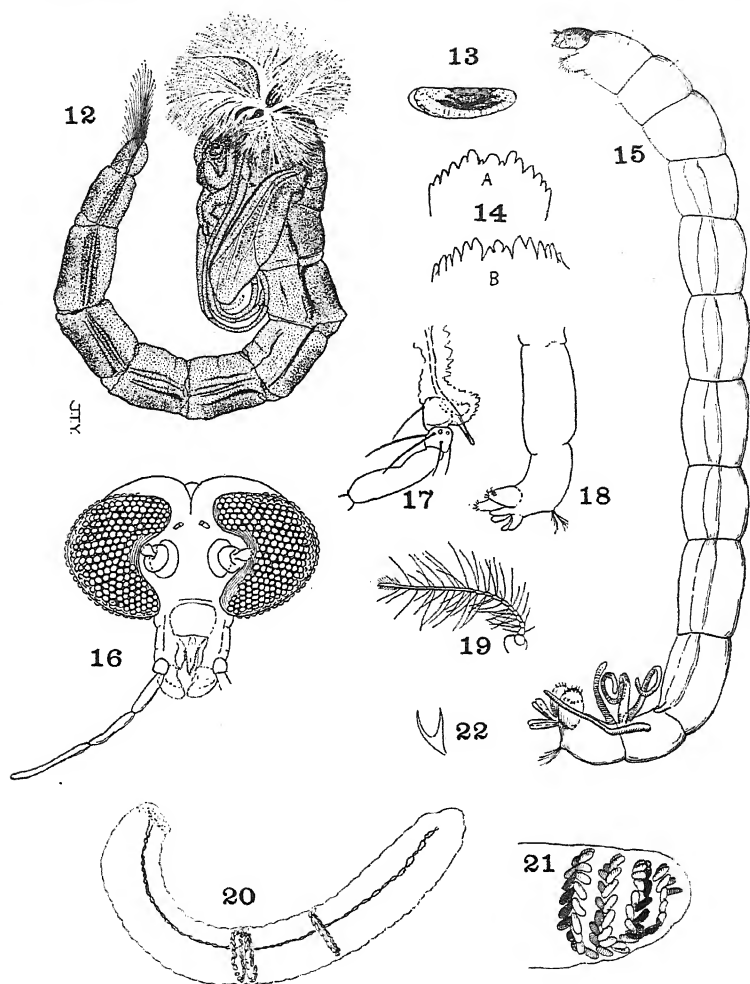


## 2

Fig. 2. *Chironomus hawaiiensis*, male wing.

The egg cylinder or rope of this species of *Chironomus* is from about 12 to 18 mm. or more long. In its periphery are imbedded many hundreds of eggs, each about 0.33 mm. long and arranged in alternating right and left loops. A pair of fine twisted fibres runs through the length of the cylinder, which is securely fastened to some object by a short stem. These slippery egg masses would not easily be grasped by fish or fowl.

The newly hatched *Chironomus* larva is nearly transparent and somewhat thicker at the thorax. There are two dark eye-like spots on the head. The anterior and posterior pairs of prolegs and the caudal gills and hair tuft are present. For some time the larva swims about freely in figure-8 fashion, but finally settles down to construct a tube of debris or whatever material is at hand, to serve as a shelter. As it grows and moults it assumes a reddish color due to the presence of free haemoglobin which assists in respiration by functioning as a carrier of oxygen. After probably the first moult, two pairs of elongate gills appear on the ventral surface of the eighth abdominal segment. Larvae may be found in numbers in their tubes that are fastened to the bottom or the sides of the pool, tank, etc. Here they may be seen reaching out from their tubes to grab flocculent mud, portions of algae, diatoms and other material as food or building material. Presumably to aid in respiration the larva frequently undulates rapidly in its tube. The pupa does this also but in less vigorous fashion. The pupa is provided with branching gill tufts of hoary white filaments that project from the prothorax, while at the depressed tail end are two rows of bristles that aid in locomotion. When the time for the eclosion of the adult nears, the pupa leaves its retreat and eventually by means of strenuous wriggling, reaches the surface; here it swims in aimless fashion and finally succeeds in breaking the surface film, an air-silvered portion of the thoracic dorsum then dryly protruding. Now the back of the thoracic integument splits apart, the adult insect almost pops out of this gap and, in a matter of a few seconds flies off with a mosquito-like hum. After an emergence of *Chironomus*, the widely-gaping pupal shells may be seen floating at the surface of the water.



CHIRONOMUS  
EXPLANATION OF PLATE IV

12. *Chironomus hawaiiensis*, pupa.
13. *Chironomus hawaiiensis*, egg. Length 0.33 mm.
14. *Chironomus hawaiiensis*: A, mental plate; B, of *Chironomus* sp. from Wailau, Molokai.
15. *Chironomus hawaiiensis*, mature larva. Length about 13 mm.
16. *Chironomus hawaiiensis*, female, front view of head.
17. *Chironomus hawaiiensis*, adult, maxilla.
18. *Chironomus* sp. mature larva, caudal end. Wailau, Molokai.
19. *Chironomus* sp., male, antenna.
20. *Chironomus hawaiiensis*, egg string; only a few eggs shown. Length of string 14.5 mm.
21. *Chironomus hawaiiensis*, egg string portion, more enlarged.
22. *Chironomus hawaiiensis*, larva, posterior pseudopod hook.

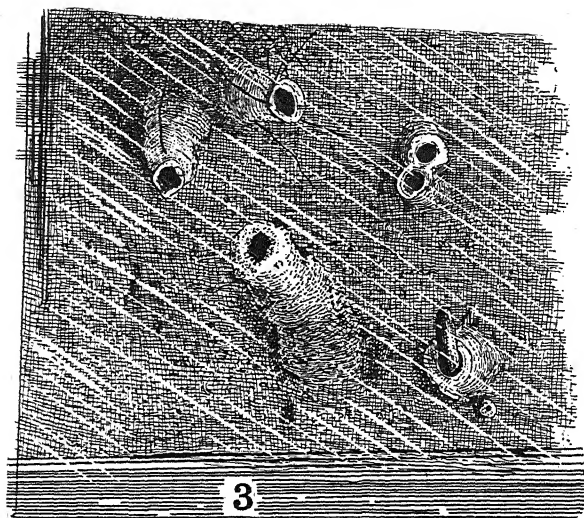


Fig. 3. *Chironomus hawaiiensis* larval tubes in the mud under water. Enlarged.

The male of *Chironomus hawaiiensis* has densely plumose antennae.

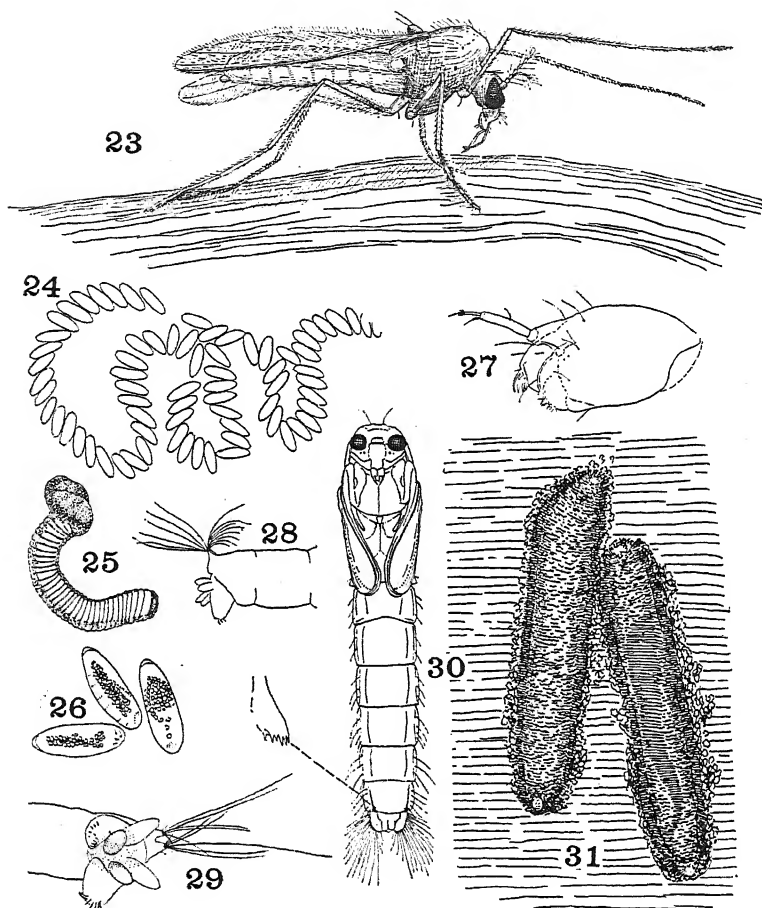
Adult *Chironomus* as well as *Tanytarsus* commonly rest with the forelegs held more or less horizontally in the air like antennae.

**Chironomus** species. (plate figures 14B, 18 and 19).

Of a much dusker shade than *Chironomus hawaiiensis*, the male with the antennae only thinly plumose and differing also in other characters from our common species, is a *Chironomus* the writer found in a tiny spring at an elevation of nearly 3000 feet above sea-level, near Wailau summit, above Mapulehu, Molokai, in December 1937. Here several adults were obtained, while among finely rooted grass in the water were some bloodworm larvae, undoubtedly of this species. Note that the larva lacks the ventral gills that are so conspicuous on the eighth ventral segment of *C. hawaiiensis* beyond the first stage.

Species of *Chironomus* have numerous enemies, such as dragon-flies, water beetles, aquatic flies and bugs, and fish. *Hydrophorus pacificus* Van Duzee, a common Hawaiian dolichopodid fly pulls the bloodworms out of shallow water and greedily consumes them. Even *Cyclops*, a tiny crustacean destroyed newly hatched *Chironomus hawaiiensis* larvae. *Cyclops* would make a short dash at a larva, hold it for a moment, severely wounding it, or, more at length consumed a good portion of its prey.

Much has been written on *Chironomus*. An excellent paper on *Chironomus cristatus* Fabr. is by Miss Hazel Branch, in the Journal



# TANYTARSUS

## Explanation of Plate V

23. Female. Experiment Station, H.S.P.A., Honolulu. Length of body 1.5 mm.
24. String of 72 eggs. Diffused by placing in water.
25. String of eggs. As deposited.
26. Eggs, more enlarged. Length of egg 0.26 mm.
27. Larva, head, last stage. Length of larva 3.8 mm.
28. Larva, caudal end, from side.
29. Larva, caudal end, from beneath.
30. Pupa, ventral view. Length 2.9 mm.
31. Pupal cases. Length 5 mm. Experiment Station, H.S.P.A., Honolulu.

of the New York Entomological Society, 31: 15-30, 3 pls., 1923. Another fine paper is Wm. O. Sadler's "Biology of the Midge *Chironomus tetans* Fabricius, and Methods for its Propagation" (Cornell University Agric. Exp. Sta.; Mem. 173: 1-25, 2 pls., 2 figs. and 20 tables, 1934). As stated by Dr. Sadler on page 3: "The purpose of the study was to determine the practicability of propagating midge larvae as a forage crop for young fish that feed mainly on living organisms." Finally, "The Natural History of Aquatic Insects", by Professor L. C. Miall, London, 1895, gives a very interesting account of *Chironomus*.

***Tanytarsus lacteiclavus* Grimshaw. (plate V).**

Grimshaw, P. H., Fauna Hawaiiensis, 3 (1): 5, Diptera, 1901. Kauai, Koholuamano, six males and two females, April 1895.

Those of us who are familiar with our mountain streams, be they ever so small, have probably observed swarms of pale green gnats hovering low over the water. These swarms, as far as observed, are composed entirely of male *Tanytarsus*; frail little flies with bushy antennae, dark eyes and a pale green body, the thorax of which is marked with deep brown. The individuals in a swarm may be seen working their way forward in the mass and then swinging to the rear.

And while *Tanytarsus* is abundant in the environment, as described, it is likewise common—presumably as the same species—in lowland reservoirs, lily and fish ponds, ditches, water tanks and even in water-containing saucers of flower pots in greenhouses.

In the laboratory, tank-bred females laid eggs, to the number of about 100, as little transparent masses or stout banners 10 or 12 minutes after issuing from the pupa. When the egg-masses are immersed in water they expand as feeble gelatinous cords. The eggs themselves are nearly transparent and about 0.26 mm. long. More than one lot of eggs may be laid by a single female. Incubation is less than two days, the glassy larva literally bursting out of a pressure rent in the shell; then there is a vigorous squirm and all but the tail end is immediately freed. The tiny larva is a good swimmer but soon settles down to construct a simple tube of debris that may be open at either end, attaching it to the substratum. Older larvae are largely greenish. The antennae are relatively long, there is a pair of prolegs at each extremity of the body and in addition posteriorly, finger-like gills and a double tuft of bristles. The pupa is pale glassy green. It may often be seen actively undulating within its debris chamber that is very thinly closed. When the time for hatching is at hand the pupa leaves its case, floats or swims to the surface and the adult issues without loss of time and flies away. This transformation was observed on numerous occasions in the grounds of the Experiment Station, Hawaiian Sugar Planters' Association, Honolulu, in the summer of 1939. Here several iron

drum tanks filled to a depth of 28 or 30 inches with water made to circulate very gently were used by a special research laboratory for studying the growth of sugar cane, a stalk of which was inserted in the water. Algal growth had developed on the sides and on some surface apparatus. Eventually *Tanytarsus* midges appeared, and I was glad of the opportunity to study the habits of these little green insects so conveniently situated. No swarming of *Tanytarsus* was ever observed here, for all seemed to be females. The larvae and pupae appeared at some depth in the drum. The flies emerged chiefly in the afternoon, although no night watch was kept. Where a moment before nothing had been observed on the surface of the water, several adult *Tanytarsus* are now to be seen. However, by watching carefully one might discover a little silvered pupa rising up in a subvertical position from the sunlit depth. Progress is fairly rapid and occasionally hastened by brisk sculling; a spot breaks the surface of the water, head, thorax and appendages appear and, with a slight pull the end of the abdomen of the delicate green midge is freed from the gaping almost invisible pupal shell. A moment's rest and the midge takes wing. The entire transformation at the surface was a matter of from 17 seconds to a little more than a minute. All the *Tanytarsus* observed and reared from this iron drum tank were females, a number of which were captured immediately after emergence and found to lay viable eggs. From one such egg mass I reared a single adult, a female. This recalls an article by F. W. Edwards entitled: "Some Parthenogenetic Chironomidae". *Ann. & Mag. Nat. Hist.*, (9) 3 (14): 222-228, 1919). Here he shows that several species of Chironomidae, including *Tanytarsus boiemicus* Kieffer, are able to reproduce without the intervention of the male.

*Tanytarsus* is sorely beset by enemies. Damselflies and dragonflies plunge into their lazy swarms, while the larvae and pupae of these midges form an important element in the food of the nymphs of these Odonata. Hawaiian fresh water goby fish, or oopu, take their toll. And as these frail flies emerge from their pupal shells at the surface of the water, particularly among algae in a quiet pool, the little water-running bugs *Microvelia vagans* (White) pounce upon them to impale them on their beaks. Nevertheless, for all these handicaps, there are many places where *Tanytarsus* breeds unmolested and, thanks to its adaptability, maintains itself in abundance.

There are several species of marine *Tanytarsus* in the Pacific. Two of these occur in the Samoan Islands (Edwards, *Insects of Samoa*, 6, Diptera, fasc. 2: 62, 1928), while four others have been described from Japan (Tokunaga, "Chironomidae from Japan



(Diptera), II. Marine *Tanytarsus*", Philippine Jour. Sci., 51: 337-368, 2 pls., 1933). The writer took a species of *Tanytarsus* flying about the seashore at Noumea, New Caledonia, in July 1940. It appears surprising that no marine *Tanytarsus* have been found in the Hawaiian Islands.

For an excellent article on *Tanytarsus dissimilis* Johannsen in Minnesota, see Cavanaugh, W. J. and Tilden, J. E.: "Algal food, feeding and case-building habits of the larva of the midge fly, *Tanytarsus dissimilis*", Ecology, 11: 281-287, 3 pls., 1930.

#### SUBFAMILY ORTHOCLADIINAE

Here belong a few species of small size, the least known and perhaps the least aquatic group of our Chironomidae. The males may be seen in swarms in the moist mountains or in gardens—and particularly over fresh compost—in the city itself. This subfamily and the Clunioninae may be separated from the Chironominae in having the first joint of the fore tarsus shorter than the tibia, as well as by other characters. From the Clunioninae, which follows this subfamily, it is distinguished by the presence of a well defined horizontal pleural suture (anepisternal suture) and by the male antennae being usually plumose.

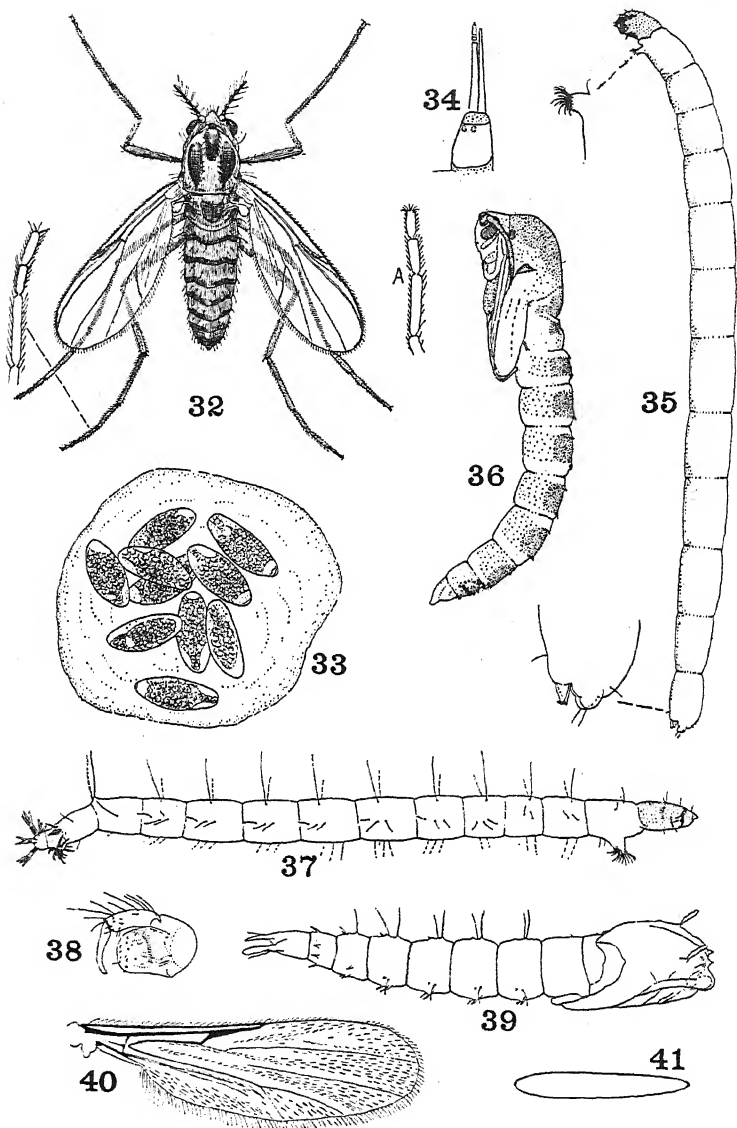
Grimshaw in Fauna Hawaiiensis, 3 (1): 5, Diptera, 1901, noted an unnamed species of *Orthocladius*.

Another undescribed species has been referred by Johannsen to the subgenus *Psectrocladius* (Bryan, E. H. Jr., Proc. Hawaiian Ent. Soc., 8(3): 404. In 7(2): 233, 1928 of the same journal. Dr. J. F. Illingworth reported that Dr. J. M. Aldrich had determined a tiny green midge which had been bred from water cultures, as *Metriocnemus* sp. (Chironomidae). The larvae of these flies constructed tubes on the walls of the dishes, reaching their heads out to feed and retracting when disturbed. "Two specimens had

#### SPANIOTOMA and APELMA

##### Explanation of Plate VI

32. *Spaniotoma* sp. female, Mt. Kaala, Oahu, 3600 ft. elevation. Length 1.5 mm.; A, *Spaniotoma* sp., female, part of hind tarsus. Honolulu.
33. *Spaniotoma* of 32A, globule of eggs.
34. *Spaniotoma* of 32A, antenna of larva.
35. *Spaniotoma* sp., larva, Mt. Kaala, Oahu, 3600 ft. elevation.
36. *Spaniotoma* sp., pupa. Length 3.3 mm. Mt. Kaala, Oahu, 3600 ft.
37. *Apelma brevis*, larva, last stage. Length 3.7 mm.
38. *Apelma brevis*, male, part of terminalia.
39. *Apelma brevis*, pupa. Length 2.6 mm.
40. *Apelma brevis*, male, wing.
41. *Apelma brevis*, egg. Length 0.47 mm.



been previously bred from material collected in a lily pond by Mr. O. H. Swezey". This very much suggests *Tanytarsus*. I have made but a single specific identification in this subfamily.

***Spaniotoma (Smittia) maculiventris* Edwards.**

Edwards, F. W., "Marquesan Insects—II", B. P. Bishop Museum, Bull. 114, Pac. Ent. Surv., Publ. 7:89, 1935. ♂.  
 "Uahuka: Putatauuu, Vaipae Valley, altitude 880 feet, September 20, 1929, one male on dead banana leaves, Adamson."

"A species with extremely distinctive coloration."

I took numerous examples of this small midge in Honolulu, during January 1941 and 1943. The males were hovering in swarms over leaf compost, the females were perched nearby. This species, probably an immigrant, is prettily marked in yellow, rich brown and black; the male is more slender and has bushy antennae, the female is more heavily marked on the abdomen with black. The larva is probably terrestrial.

***Spaniotoma* No. 2 (plate figure 32).**

Slightly larger than the preceding. The female is 1.5 mm. long, the male longer. The head and thorax are pale yellowish, the mesonotum having three dark and wide parallel stripes, the abdomen is grayish green, darker apically, and the legs grayish. This species is common about a spring at 3600 feet altitude, on Mt. Kaala, Waianae Mts., Oahu. Some of these flies were taken on foliage by this spring in 1938 and 1939, while a number were reared from masses of fine roots and diatomaceous material that were water soaked or sheeted over with water. The larva and pupa (figs. 35 and 36) taken from this locality may be this species.

***Spaniotoma* No. 3 (plate figures 32A, 33 and 34).**

About 1.35 mm. long and with the median stripe extending the entire length of the mesonotum. A few females were taken, chiefly on windows in Honolulu. One of these laid 10 eggs as a glassy globule on the wet cotton stopper of a test tube. The eggs measured about 0.24 mm. long. A well-grown larva has a well developed anterior proleg; the posterior proleg is less developed and is sparsely provided with a few strong hooks. The larvae kept more or less submerged in some felt-like algae. They were unable to swim. The pupa much resembles that figured (36) from Mt. Kaala. It is provided with 3 bristles on each side near the eyes, while at the caudal end are 2 spines on each side of the gently bilobed median part, the outer spine the longer. The abdomen is finely roughened.

**Spaniotoma No. 4.**

One pale colored female specimen of what appears to be a *Spaniotoma* with some macrochetae along the wing veins. From Palikea, Waianae Mts., Oahu, 2,000 ft., November 15, 1936, on mossy ground.

**Metriocnemus No. 1.**

One male and 2 females of a hairy-winged midge that appear to belong to this genus. Mt. Olympus, Koolau Mts., Oahu, 2,100 ft. Reared February 2-9, 1939 from muddy moss.

The female is the more hairy winged.

**Metriocnemus No. 2.**

Six males from the spring at 3,600 ft., Mt. Kaala, Oahu, November 13, 1937 and December 26, 1938. On foliage.

A good account of the early stages of *Metriocnemus lundbecki* Johannsen in Illinois, is given by Dr. J. R. Malloch in Proc. Ent. Soc. Washington, 16: 132-136, 1 pl., 1914.

## SUBFAMILY CLUNIONINAE

In his key to the known genera of Clunioninae, Edwards ("Diptera of Patagonia and South Chile"; British Museum Publication, 2, [fasc. 3]—Chironomidae: 31, 1931) places seven genera. Two of these—*Telmatogeton* and *Clunio* are represented in the Hawaiian Islands.

About 12 species of *Telmatogeton* have been recognized. The genus has representatives in South Africa and the Indian Ocean, South Australia, Japan, the Marquesas and the Hawaiian Islands and South Chile. With the exception of four Hawaiian species that inhabit mountain streams they are marine insects. A fifth species found along Hawaiian seashores was first taken in the Marquesas Islands to the south.

The habits of these insects are of great interest, and the Hawaiian species particularly need further study. They do not hover in swarms as do many other midges to the contrary; nevertheless the males especially, are very active insects and may often be seen racing about as if distraught—half running, half flying at the very margin of mountain torrents, rushing flume waters, or over wave-washed sea rocks. The eggs are laid singly or in groups where they are submerged or at least wet; the larvae construct more or less of a silken tube and seem incapable of swimming; the pupae are cylindrical with a large chitinous disk terminating the posterior extremity.

**Telmatogeton pusillum** Edwards.

Edwards, F. W. "Marquesan Insects—II", B. P. Bishop Mus., Bull. 114, Pac. Ent. Surv. Publ. 7: 88, 89, 1935. "Eiao: Vaituhu, October 2, 1929, 6 males, 3 females at light, Adamson."

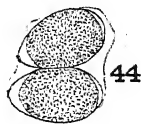
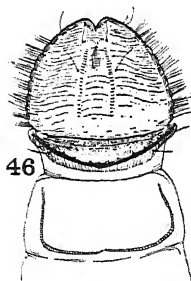
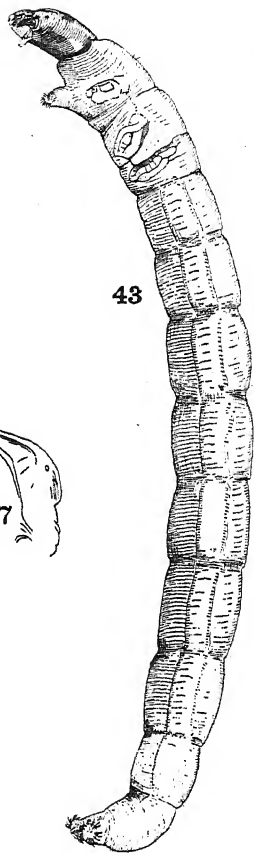
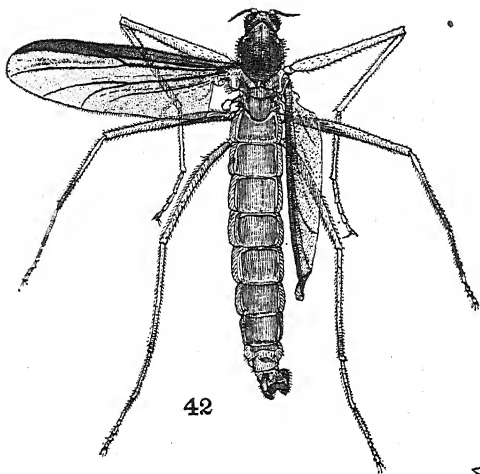
Specimens taken on a wave-drenched boulder at Waimanalo, Oahu, June 3, 1936, were identified by Mr. Edwards (at the British Museum) as this species. It is also found on the Waianae shore of Oahu. The adult fly measures from a little less to a little more than 2 mm. long and seems to be the smallest described species. The general color is brownish with the thoracic dorsum more or less gray pruinose and the wings a sort of dull smoky whitish, dark at the costa. It is long legged and ungainly. It is common at the upper tide belt where there is plenty of tufted oakum-like, pale yellowish green algae of the genus *Ectocarpus* (*Phaeophyceae*, or brown algae). Here it may be seen racing in erratic fashion over the tide-washed rocks, and then taking wing. It appears able sometimes, to withstand the impact of the waves, for when one of these has receded the fly is immediately to be seen resuming its dodging course over the rocks. I have not observed it avoiding a wave by flight, as does to the contrary the little canacid fly of the sea rocks.

This fly was difficult to capture when active but could be bottled readily enough while at rest on coral ledges. When a stone bearing a quantity of *Ectocarpus* was immersed in fresh water, a number of *Telmatogeton pusillum* larvae appeared. These rather sluggish, non-swimming larvae had dark brown heads and olive green and brown bodies with sparse erect hair and anterior and posterior hook-bearing prolegs. At eclosion the pupa is extruded from its neat tubular retreat. The eggs were not observed.

## TELMATOGETON

## Explanation of Plate VII

42. *Telmatogeton torrenticola*, male. Length 5.5 mm. East Molokai.
43. *Telmatogeton torrenticola*, larva. Length 14.5 mm. East Molokai.
44. *Telmatogeton* sp., eggs. Waianae, Oahu.
45. *Telmatogeton* sp., pupa. Length 7.5 mm. Waianae, Oahu. Appendages loosened from proper position.
46. *Telmatogeton* sp., pupa, caudal end, viewed obliquely dorsad. Waianae, Oahu.
47. *Telmatogeton* sp., pupa, breathing horn and side of thoracic dorsum. Halemanu, Kauai.



This fly is sometimes found in company with *Clunio* sp., a smaller marine dipter.

***Telmatogeton abnormis* (Terry).**

Terry, F. W., Proc. Hawaiian Ent. Soc., 2: 292, 295, plate 7, figures 6, 7, 8 and 9, 1913 (*Charadromyia* Terry). Habitat, Kilauea, Kauai.

This fresh-water species measures about 2.7 mm. in length of body. It has thus far been found only on the island of Kauai.

***Telmatogeton* sp. 1. (plate figures 44-46).**

This insect has been confused with *T. torrenticola* of Maui and Hawaii, from which it differs by its smaller size, the character of the tarsal claws, etc. It is more nearly related to *T. abnormis*. It occurs both in the Koolau and the Waianae ranges of Oahu. While usually inhabiting well-forested regions it has in some cases followed swift-water ditches to the more open lowlands. It has for example, established itself in the hot semi-arid Waianae valley where it breeds along the algal margins of a cement-lined ditch that carries swiftly-running water. Here the adult fly often falls victim to the foraging fire ants (*Solenopsis geminata* [Fabr.]).

Dr. J. F. Illingworth, in a short paper entitled "Insects in the Waiahole Ditch" (Proc. Hawaiian Ent. Soc., 7: 408-409, 1931) reported this insect as one of the chief constituents of masses of insects that piled up in a back eddy of this long open canal: The floating mass was composed largely of their pupae and cast larval skins. The adults were emerging in numbers." This *Telmatogeton* is common along rapid streams that have their origin behind Honolulu. In upper Manoa valley it is usually found at waterfalls, but I have seen an individual frantically racing about an area of less than a square foot on a steep wetted rock in a stream. It is often swept downstream but works its way up again. In its apparently aimless but swift progress at the water's edge it often collides with the dense groups of *Scatella* flies busy with courtship and feeding activities. Sometimes several male *Telmatogeton* in seeking to court the quieter female became involved in quite a tangle. The shining, dark-tipped eggs are found in clusters slightly under water or at its edge. Eggs kept in the laboratory hatched in about a week. The dusky olive larvae are non-swimming, provided with the usual prolegs and almost devoid of hair. They live in silk-lined tubes among algae that may be more or less exposed in the rapid marginal water: or they may be submerged an inch or two, where for example water curves swiftly over a rounded boulder. On one rock plane that was shallowly sheeted by rapid water their numerous silken-white galleries showed very conspicuously.

*Telmatogeton torrenticola* (Terry). (plate figures 42 and 43).

Terry, F. W., Proc. Hawaiian Ent. Soc., 2 (5) : 292-294, plate 7, figures 1-5 and 10-16, 1913 (*Charadromyia*). "Hab. Types ♂ and ♀ Nahiku, Maui (400-800 ft.) also Lahaina, Maui (1000 ft.); Kohala, Hawaii (1200-1500 ft.) Terry coll."

"In rapid streams and waterfalls". It appears to be this species that is found in the mountains of Molokai.

This is a duskier and much larger species than the two preceding, for it attains a length of body of about 5.3 mm. and a wing length of 5 mm. Besides occurring along mountain streams it is a common sight about rapid ditch water and along the often very swift water in the wooden flumes that traverse fields of sugarcane.

Terry (l.c.) has notes on the life history of this midge. The eggs are .3 mm. long and are deposited in single layers "often consisting of several thousands in a mass, evidently the product of several females". The larvae are at first greenish and later olivaceous and attain a length of 18-20 mm.

The fly probably has its share of enemies, but my only note on this subject refers to what seemed to be quite an ambitious *Lispocephala* fly (Anthomyiidae) attempting to overcome a *Telmatogeton* midge about as large as itself, at Akaka Falls, Hawaii.

*Telmatogeton* sp. 2 (plate figure 47).

This is our largest chironomid and apparently the largest species of the genus—in a series of ten specimens the body length ranges from 4.6 to 7.10 mm. while the wing length ranges from 6 to 7.7 mm. Apart from its superior size however, it is readily distinguished from the others by the relatively long and erect hair on the legs. It was taken on the Kauaikinana stream at Kokee, Kauai, September 6, 1919, by H. T. Osborn. The altitude here would be over 3000 ft.

Some of the marine *Telmatogeton* have received considerable study and the reader is referred to the following papers:

Hesse, A. J. 1934 "Contributions to a Knowledge of S. African Marine Clunione-Chironomids: (A) The Early Stages and Ecology of *Telmatogeton sancti-pauli* Schin. (= *Trissoclunio fuscipennis* Kieff.) from the Cape Coast." Trans. Royal Ent. Soc. London, 82: 27-40, 4 text-figures.

Tukunaga, M. 1935. "Chironomidae from Japan (Diptera). 4. The Early Stages of a Midge, *Telmatogeton japonicus* Tukunaga". Philippine Jour. Sci., 57: 491-511, one text-figure, 3 pls.

Womersley, H. 1936. "An Interesting Chironomid *Telmatogeton australicus* sp. n. from a South Australian Reef." Records of the South Australian Mus., 5: 439-443, 2 text-figures.



The genus *Clunio* (text-figures 4-6) consists of very small marine flies, the males between 1 and 2 mm. in length, with broad milky white wings, the females without wings. It is represented on the coasts of Europe, Japan, Samoa and the Hawaiian Islands, including Midway Island. These flies breed in the intertidal zone, but the European *Clunio marinus* Haliday may also be found in its immature stages among the algae to a depth of 15 meters (Goetghebuer, M. "Faune de France, 23, Dipteres Chironomidae", 4: 143, 1932). The larvae which are provided with anterior and posterior prolegs, construct shelters of silk interwoven with sand and debris.

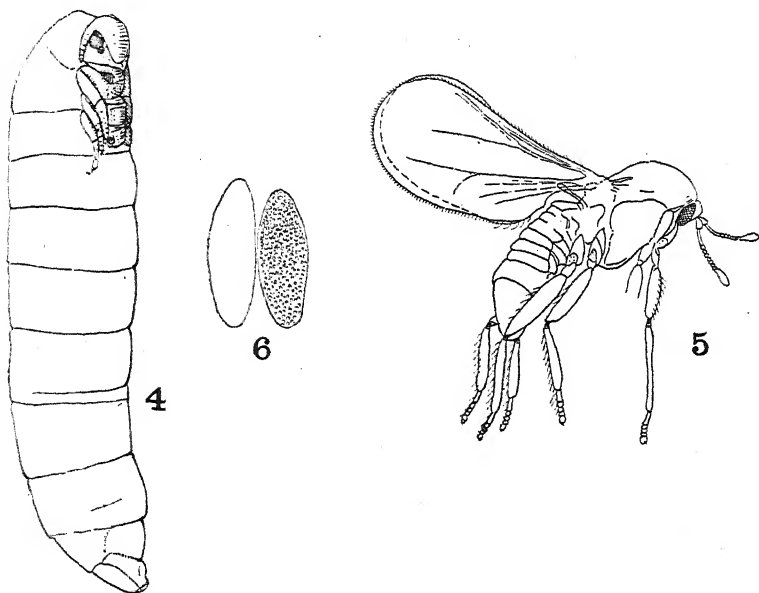


Fig. 4. *Clunio* sp., female pupa. Enlarged. Hanauma Bay, Oahu.

Fig. 5. *Clunio* sp., male. Enlarged. Midway atoll.

Fig. 6. *Clunio* sp., eggs. Length 0.24 mm.

The male *Clunio* are very active in their wild scampering progress low over the wet sea rocks, as they search for females exposed by the receding tide. One or more males would locate a female among the short green rock algae. Pairing was brief, the attached male buzzing its wings, the female remaining on the substratum. A few pairs were captured by means of a suction apparatus, or aspirator. A female that was confined in a vial laid a long gelatinous string of eggs, the latter being arranged at right angles to this string.

Males were often seen floating in little rock pools.

A series of *Clunio* taken at three points on Oahu: Hanauma Bay, Waimanalo and the Waianae coast were sent to the British Museum where Mr. F. W. Edwards determined them as three apparently undescribed species, each from its own locality. The writer also took male *Clunio* on the beach of Midway atoll, 1300 miles northwest of Honolulu, in the summer of 1941. But probably the earliest capture of *Clunio* in the Hawaiian Islands is represented by a male specimen taken by Mr. O. H. Swezey at Kaimuki, Honolulu, November 10, 1915.

Among the papers referring to marine Clunioninae are:

Edwards, F. W. 1926. "On Marine Chironomidae (Diptera); with Descriptions of a New Genus and Four New Species from Samoa"; Proc. Zool. Soc. London: 779-806; figs.

Buxton, P. A. 1926. "The Colonization of the Sea by Insects: with an Account of the Habits of *Pontomyia*, the only known Submarine Insect"; Proc. Zool. Soc. London: 806-814.

Saunders, L. G. 1928. "Some Marine Insects of the Pacific Coast of Canada"; Ann. Ent. Soc. America, 21: 521-545; figs.

Tokunaga, M. 1933. "Chironomidae from Japan (Diptera) I. Clunioninae"; Philippine Jour. Science, 51: 87-99; 2 pls.

#### FAMILY CERATOPOGONIDAE (The Biting Midges)

This is a large family of small flies, the females usually of stout form, the males more slender and with bushy antennae. Their larvae may be aquatic, subaquatic or terrestrial. The family is lucidly dealt with by Edwards ("On the British Biting Midges [Diptera, Ceratopogonidae]"; Trans. Ent. Soc. London, 74: 389-426; pls. XCI-XCII and 3 text figs., 1926.).

While our few Ceratopogonidae appear to be of little economic importance, the family elsewhere contains many serious pests—i.e. those of the genera *Culicoides*, *Ceratopogon*, *Lasiohelea* and *Lep-toconops*. These are often referred to as punkies, no-see-ums and sand flies. Several are disease carriers.

A number of species of Ceratopogonidae suck the blood of insects, attaching themselves to the wings or the body of their host. Among these hosts are dragonflies, butterflies, crane-flies (Tipulidae), mosquitoes and the caterpillars of butterflies and moths.

Among the papers referring to this subject, are:

Knab, F. 1914. "Ceratopogoninae sucking the blood of other insects"; Proc. Ent. Soc. Washington, 16: 139-141 (hosts: *Anopheles*, *Culex* and Lepidoptera).

Macfie, J. W. S. 1936. "Four Species of Ceratopogonidae (Diptera) from wings of insects"; Proc. Royal Ent. Soc. London, B. Taxonomy, 5: 227-230 (hosts: Odonata and tipulid flies).

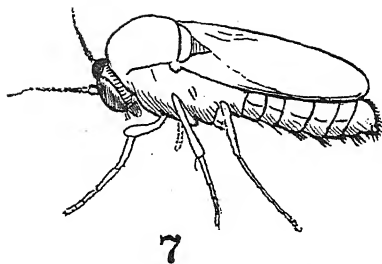


Fig. 7. One of the Ceratopogonidae, female. Enlarged.

Macfie, J. W. S. 1937. "Notes on Ceratopogonidae"; *ibid*: 111-118 (hosts: Odonata and the larva of the noctuid moth *Laphygma eximpta*).

Lever, R. J. 1940. "A Ceratopogonid fly attacking a caterpillar in Fiji"; *Ent. Mo. Mag.*, (IV) 1: 55; note by F. W. Edwards.

In the Island of Trinidad, B.W.I., a species of *Forcypomyia* is considered as most probably a cross-pollinator of the cacao tree (*Theobroma cacao* L.) (Billes, D. J., 1941. *Tropical Agriculture*, 18 (8): 149-156).

E. H. Bryan, Jr. in his "Review of Hawaiian Diptera, with Descriptions of New Species" (*Proc. Hawaiian Ent. Soc.*, 8: 405, 447, 1934), lists *Apelma brevis* Johannsen and three *Ceratopogon* species, of which one was determined by Dr. Johannsen as the subgenus *Prohelea*. The writer took four species of this family in the Hawaiian Islands, as follows: *Forcypomyia ingrami* Carter, *Apelma brevis* Johannsen, *Dasyhelea hawaiiensis* Macfie and *Dasyhelea calvrescens* Macfie. Additional species should be found here.

***Apelma brevis* Johannsen.** (plate figures 37-41).

Johannsen, O. A. "A New Midge injurious to Pineapples (Diptera, Ceratopogoninae)". *Proc. Ent. Soc. Washington*, 29: 205, 207-208, 1927. Describes ♂ and ♀ and larva and pupa. *Apelma* is placed under *Forcypomyia* by Edwards.

This is a tiny brownish midge somewhat over a millimeter in length. It was observed by Dr. J. F. Illingworth as—"omnipresent in the water pockets in the axils of pineapple leaves—" (*Proc. Hawaiian Ent. Soc.*, 7: 206, 1929). Subsequently, Dr. Illingworth (*ibid*, 8: 541-543, 2 figs., 1934) gives a brief account of its life-history and habits. He gives the incubation period of the dark cigar shape eggs as four days, the length of the larval stage from 28 to 45 days and the pupal stage four days.

The adults may be seen in small numbers flying in jerky zigzag fashion about pineapple plants (*Ananas sativus* Schultes, Bromeliaceae).

Most of my observations on this insect were made in November 1938, in a long abandoned planting of pineapples in the forehills of Punaluu valley, Oahu. Many young plants were examined. In addition to *Apelma*, larvae of the curious fly *Stenomicroa orientalis* Malloch (Asteidae), of sidling gait, were observed breeding between the leaves.

The eggs of *Apelma* were found fastened for their length towards the tip of one of the innermost leaves and well above any axillary water. The pupa is active but cannot swim.

***Forcypomyia ingrami* Carter. (plate VIII).**

Carter, H. F., Ann. Trop. Med. and Parasit., 12: 290, 1919.

Described from West Africa. Ingram and Macfie, Ann. Trop. Med. and Parasit., 18: 584, 1924.

Occurs also in the Marquesas Islands, Samoa, Sumatra, Malaya, Trinidad, (B.W.I.) and doubtless elsewhere.

*Forcypomyia ingrami* is probably a widespread insect in the Hawaiian Islands. On the big island of Hawaii it has been taken at Kilauea, 4000 ft. (O. H. Swezey); and at Nauhi, 5200 ft. (O. H. Swezey and F. X. Williams); on Oahu it has been collected from the lowlands to the highest peak (4028 ft.). It may be very common in Honolulu during the wetter months—when more breeding places exist—the adults hovering in swarms before sunset about the gables of houses, the more prominent portions of the taller plant growth, or they may even use the gardener's head as a rallying point. Occasionally these swarms—which seem to consist almost entirely of males—become a nuisance. In December 1936—January 1937, following heavy rains, this midge invaded dwellings in certain parts of the city in annoying numbers. *Forcypomyia*, together with certain other small flies, is often attracted to freshly painted surfaces.

In the mountains one often observes their swarms dancing alongside trees and bushes.

When enclosed in vials stoppered with moist cotton or cloth, *Forcypomyia* often laid masses of glassy white eggs shaped like fat cigars, the mass swelling on being placed in water. The eggs are about 0.30 mm. long. In less than a week they hatch into glassy white caterpillar-like larvae with a large head bearing reddish eyespots and some dark shade at the mouth and within the head, both head and body being provided with club-like hairs and hairs of ordinary type. A large horn-like pair, the antennae, adorns the head in front of the eyes. Well forward on the breast is a large pseudopod by means of which the insect drags itself along. The mandibles play with alternate down and backwards strokes.

A number of well-grown *Forcypomyia* larvae were observed in the upper part of Hering Valley behind Honolulu, and living speci-

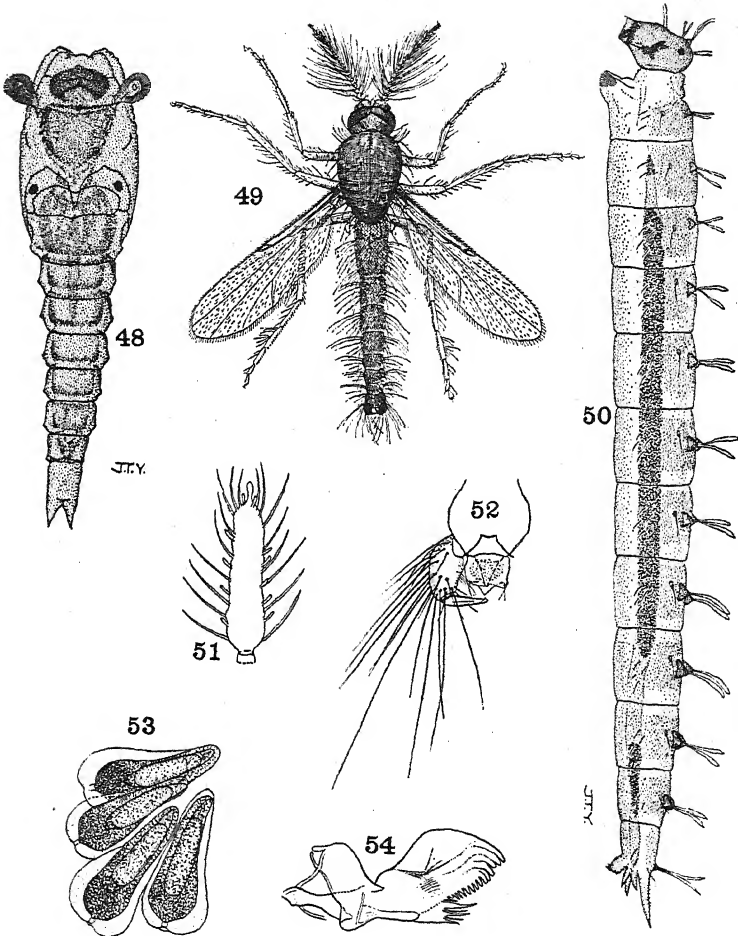
mens were brought to the laboratory for study. As this odd-looking creature rests with the lower part submerged, upon a wet leaf or bank, we note on its back the pairs of thickened, mostly club-shaped hairs arising from darkish cones, and often bearing a droplet of moisture while along the sides, curved hairs appear to support the insect in its upright position. It is very shiny and gleams somewhat reddishly beadlike in the light. The curious large head that is carried rather upright is somewhat elongate and tapers to the square-cut mouth, the two dark eyespots with a horn-like antenna before each; all help in the writer's mind to give the larva of *Forcypomyia* a decidedly bovine countenance. A note of June 13, 1933, on several well-grown larvae may be rendered as follows: "This morning beside the tiny stream in Hering Valley I watched several *Forcypomyia*. They were travelling slowly on a very wet leaf, their curved lateral hairs apparently resting on the thin sheet of water seeming to steady them. At the tail end and probably functioning as a blood gill is the extrusible delicate tapering process that is hair-fringed basally and extends upon the water. Here too is a terminal rosette, and some fine hooks that probably serve for anchorage when necessary. No tracheae were discerned. As the larva slowly advances, it moves its head from side to side with the mouth applied to the smooth surface of the leaf, the thin, shell-like mandibles probably scraping off fine material. A large larva was observed tilting its head forward and bring its mouth on a level with the surface film of water, when the mouth-parts, brush-like were seen moving with so great a speed as to draw a current towards them. As *Forcypomyia* slowly moves forward—and it seems unable to go backward—its progress is seen to be of a somewhat trembling or finely jerky character, due to the repeated strokes of the duplex proleg under the thorax. There is no humping up and forward, such as takes place in caterpillars, visible here. When a larva meets another, one of these will swerve swiftly aside; in fact if sufficiently disturbed, it may swing over far enough to reverse its position. I found that the most satisfactory way of capturing these tiny creatures was to drive them onto a bit of wet leaf which could then be

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## FORCYPOMYIA INGRAMI

### Explanation of Plate VIII

- 48. Pupa, dorsal view.
- 49. Male.
- 50. Larva.
- 51. Male, last article of antenna.
- 52. Male, part of terminalia.
- 53. Egg cluster. Length of egg 0.45 mm.
- 54. Larval mandible.



lifted up. They float quite well, when they are able to make some progress by writhing very fast. Surface tension draws them quickly to nearby objects. They are helpless on a smooth surface under water.

In the laboratory the pale brownish pupae could be found, back up, upon a wet leaf, mass of algae, etc., the two, somewhat funnel-form respiratory trumpets protruding through the water film that covers the body itself. While apparently unable to swim, and indeed, open water is not their habitat, the pupae when turned over in the water so that the funnels are ventral and underwater, will by means of a jerk or a squirm or two, very neatly turn over on their back. The adult issues through a gaping crack made in the back of the pupa.

*Forcypomyia ingrami* breeds in a variety of situation. At Kilauea, Hawaii, in October 1929, Mr. O. H. Swezey secured a number of the adult flies from well-watered cabbages, between the leaf bases of which there was some detritus and decay and where no doubt the larvae were feeding. At Nauhi, Hawaii, in September 1931, *Forcypomyia* larvae were found at the base of the spathe of the calla lily (*Richardia aethiopica* Spreng., Araceae) where water and debris collect. The immature stages may be very common among wet leaves and trash in the forest as well as in the dense cover of the uluhi fern (*Gleichenia linearis* [Burm.] Clark).

The adult females of some species of *Forcypomyia* are known to suck the juices of other insects, notably the larvae and adults of lepidoptera, and to quote Edwards on *ingrami* (Insects of Samoa, pt. VI, Diptera, fasc. 2, Nematocera; 51, 1928): "In West Africa the larvae were found by Ingram to be semi-aquatic and to prey on mosquito larvae."

Among the enemies of this insect in Hawaii are dragonflies and damselflies, *Pantala flavescens*, for example, flying back and forth through the swarms of these midges, while their larvae are preyed upon by the nymphs of damselflies that occur in similar situations.

An excellent, finely illustrated paper on several species of *Forcypomyia* has been written by L. S. Saunders: "On the Life History and the Anatomy of the Early Stages of *Forcypomyia* (Diptera, Nemat. Ceratopogoninae)"; Parasitology, 16 (2) : 164-213, 26 textfigures and 3 plates, 1924.

***Dasyhelea hawaiiensis* Macfie.** (plate figures 60-63).

Macfie, J. W. S., Stylops, 3 (6) : 133-134, 1 fig., 1934.

This tiny fly is about 1.25 mm. long and a sort of dark gray brown with the halteres conspicuously yellow. The male is more slender than the female and has plumose antennae.

The females may be seen in the daytime in low irregular zigzag flight, passing, or pausing over or alongside dripping wet banks that

are more or less clothed with such plants as dwarf ferns, moss, filamentous green algae, like *Cladophora*, and glistening, water-soaked masses of brown diatoms commonly of two kinds, the filaments of one made up, of waffle-shaped units, and those of the other, of deeply fluted sub-cylindrical ones. In addition, there would be fine intermingling soil, dead leaves and other organic matter.

*Dasyhelea*, difficult to follow because of her very small size, will alight upon a wet spot, walk a bit, perhaps fly off a few inches, hover, alight again, and for a while remain quiet. She was not observed in the act of oviposition, but her egg-masses are sometimes to be found attached to saturated algae alongside a thin waterfall, and captive flies often deposited eggs readily. The eggs, each enveloped in a clear elastic gelatinous substance, adhere to one another to the number of a few individuals to several dozen to form subglobular masses (fig. 62). At first pallid, they turn a sort of smoky brown; they are rather firm of shell and although really elongate, are doubled up short, as if mindful of their stubby parent on the one hand and of the slender larvae that are destined to hatch from them, on the other. The eggs measure from about 0.20 to 0.25 millimeter in their longer doubled-up diameter, the projecting portion being the head end. In due time two eye spots and a sort of throat, or pharyngeal skeleton may be seen through the eggshell and a day or so later the tiny larvae hatch out. They have a pale brown head, but the body is nearly transparent and lacks any pseudopod or false foot. The mandibles may be seen under the fore part of the head in alternate down and backwards movement suggesting grappling hooks. Throughout its life of several weeks in a water-soaked, or even quite immersed mass of algae, diatoms, etc., it is unable to swim but can travel swiftly snake-like a short distance among the plant filaments, and here even the mandibles may assist in locomotion, when it must pull itself along. There are a few erect hairs at and towards the tail end of the body, at the very extremity of which are four delicate tapering processes that are retractile and probably function as blood gills. A very delicate system of fine longitudinal tracheae is to be seen along the greater length of the body. Although no air was discernible within the larva, the latter went through motions—with its head to the surface—suggesting that it did drink in air.

When mature, the *Dasyhelea* larva is pale yellowish or orange brown and a little over 4 millimeters in length (fig. 60). As the time for transforming into a pupa approaches, the thorax becomes clearer than the rest of the body and swells considerably but with its three divisions marked off by strong incisions, while beneath the skin of the prothorax the two respiratory trumpets of the pupa



extending obliquely from back to breast, are clearly visible. During the act of pupation—which is quite rapid—these two long ear-like organs flip up simultaneously, being released as the old larval skin slips off the pupa. The light brown pupa, heavier than water and rather sluggish, is quite unable to swim, though twisting its abdomen in a tortuous manner. Like the larva, it frequently remains in fine water-soaked plant growth where it is able to work its way among the tangle of filaments and keep the back of the distal part of the breathing trumpets to the surface, anchoring itself firmly against any current by means of the two laterally-projecting horns at the extremity of the abdomen. When the time for the emergence of the adult is at hand, the pupal skin splits at the head and thorax above and the tiny fly crawls out, clings for a time to the anterior end of the now rather distended pupal shell and then flies off. The top of the thorax in such freshly issued flies, as noted in a female, is a rich brown color.

This insect has been found from nearly sea level to an altitude of over 2000 ft. Its larvae may be very numerous among algae thinly covered by flowing water, and I suspect that it is much preyed upon there by the nymphs of our large *Megalagrion oceanicum* damselfly.

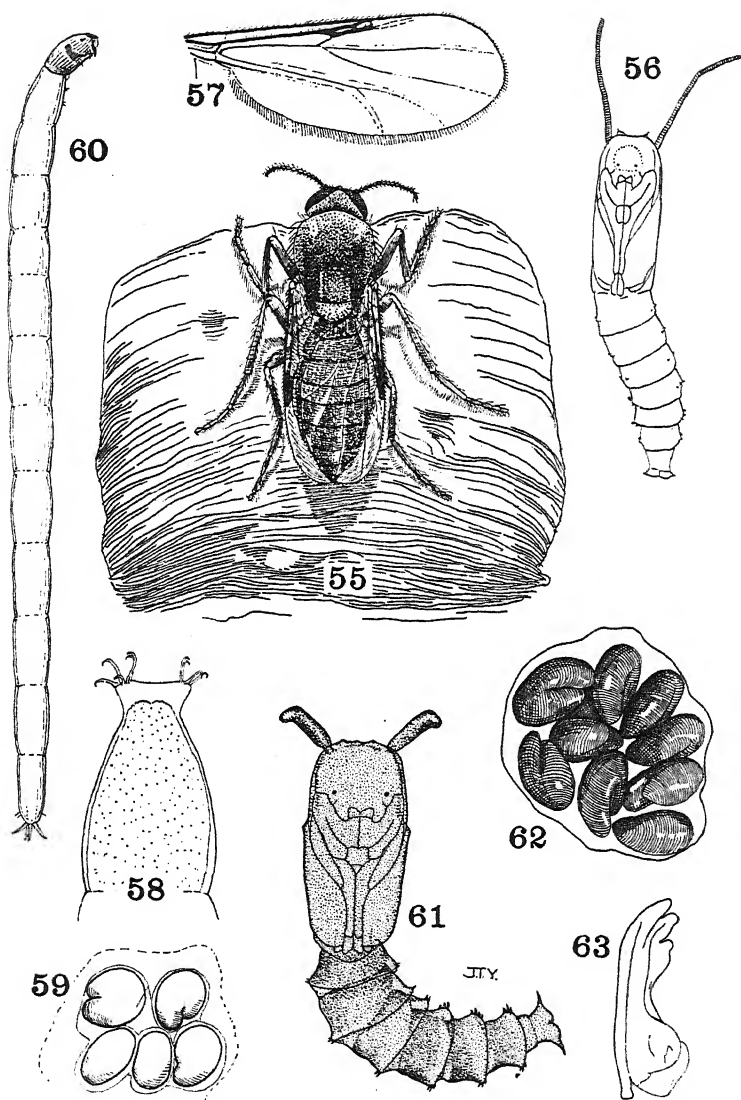
In addition to its dripping wet-bank habitat, this species also breeds in the leaf axils of *Dubautia laxa pseudoplantaginea* Skottsb. (family Compositae, tribe Senecionideae), a shrub that thrives in the cloud zone of our mountains. First observed on March 31, 1935 by Mr. O. H. Swezey (Proc. Hawaiian Ent. Soc., 9 (2) : 206, 1936), who refers to the insects found on this *Dubautia* "A few yellow mycetophilid (?) larvae were in moisture at the bases of the leaves", it has thus far been found in leaf axils far up the slopes of Mt. Olympus behind Honolulu. Both the larger larvae and the pupae are a sort of orange red. The pupal shells may be found on *Dubautia* leaves.

Further collecting will probably show that this insect is widely distributed over the higher parts of the Koolau Mountains.

#### DASYHELEA

##### Explanation of Plate IX

55. *Dasyhelea calvescens*, female. Length about 1.6 mm.
56. *Dasyhelea calvescens*, pupa.
57. *Dasyhelea calvescens*, male wing.
58. *Dasyhelea calvescens*, larva, caudal end; not all the hooks are shown.
59. *Dasyhelea calvescens*, egg cluster. Egg about 0.18 mm. long.
60. *Dasyhelea hawaiiensis*, larva, last stage. Length 4.05 mm.
61. *Dasyhelea hawaiiensis*, pupa.
62. *Dasyhelea hawaiiensis*, egg cluster. Length of egg 0.21 mm.
63. *Dasyhelea hawaiiensis*, larval mandible.



*Dasyhelea calvescens* Macfie. (plate figures 55-59).

Macfie, J. W. S., Proc. Zool. Soc. London, series B, taxonomy, 7: 157, 158, 1938. Described from Hanauma Bay, Oahu, May and June 1936.

To quote Dr. Macfie (l.c.: 157): "A small very dark brown or blackish species, with wings almost entirely devoid of macrotrichia, scutellum very dark brown, halteres with white knobs and femora and tibiae dark brown." The posterior part of the scutum is rather depressed mesad, and this part and particularly the scutellum are of a paler shade. Length about 1.6 mm.

This maritime midge may be the species found by J. C. Bridwell in a salt marsh at Waikiki, Honolulu, May 30, 1919, and referred to by him as a species of *Ceratopogon* (Proc. Hawaiian Ent. Soc., 4: 284, 1920).

It is common along the shores of Oahu appearing in the hot sunshine, buzzing in tiny, more or less zigzag movements close over the rocks back of the beach or nearer the upper tidal zone.

It is an insect of the highest tidal zone and of salt water canals (the Ala Wai canal). It also breeds in the upper splash pools. The female midge when freshly hatched has a distinct orange tinge. Eggs were secured in December 1939 from flies taken about the low tide level along the Ala Wai canal. Here *Dasyhelea* was running and flying, almost hugging the exposed area that was plentifully supplied with fine low algal growth, and with white tooth-like barnacles also present. The eggs, each enveloped in clear jelly, are laid in small globule-like batches. They much resemble the eggs of *Dasyhelea hawaiiensis* but are not so dark and measure about 0.18 mm. long. The larva is very slender and is provided with grapple-like hooks posteriorly. It shows some ability to swim. The pupa has very long breathing horns and a pair of stout, laterally spines posteriorly. Both larva and pupa are orange.

This midge is preyed upon by *Cymatopus acrosticalis* Parent, the dolichopodid fly that patrols the sea rocks.

## PART IV

### LEPIDOPTERA OR MOTHS AND BUTTERFLIES

There are many kinds of lepidoptera, the caterpillars of which feed upon aquatic plants, but the ones that are modified for an aquatic or subaquatic life are relatively few. These belong to the moth family Pyralidae, and live upon such plants as rice (*Oryza*), pond weed (*Potamogeton*) and water lilies (*Nymphaea*). In addition to the above species that inhabit quiet waters, there are a few others that are found, both as larvae and pupae, wholly submerged in swiftly running water. Here the larvae live beneath sheets of

spun silk and feed on algae. (Lloyd, J. T., "Lepidopterous Larvae from Rapid Streams"; Journ. New York Ent. Soc., 22: 145-152, 2 pls., 1914. *Elophila fulicalis* Clemens, in New York State). Another interesting species of much the same habits is *Aulacodes simplicialis* Snell that was observed by Messrs. F. Muir and J. C. Kershaw in 1908, in a mountain stream in Lappa, "a mountainous island on the western side of the harbour of Macao", China. The larvae lived sometimes at a depth of 18-24 inches under swiftly flowing water. The cocoon is so constructed as to allow the passage of water through it and at the same time keep the pupa dry. And to quote, on p. xlv: "The adult moth readily takes to water when frightened, diving below the surface and using the legs for swimming—" (Notes on the Life-History of *Aulacodes simplicialis* Snell"; Proc. Ent. Soc. London, 1909: xl—xlv, 4 figs. Transmitted by Prof. E. B. Poulton).

The flightless form of the female of the European *Acentropus nixens* Ol., the larva of which lives on *Potamogeton*, passes its life in the water. It swims, by means of its modified posterior legs, near the surface of the water where it mates with the male, then sinks, lays her eggs on the submerged plant and dies. (See Karny, H. H. "Biologie der Wasserinsecten": 159-160, fig. 102, 1934 [aus Lampert]).

The genus *Nymphula* (= *Hydrocampa*) is widely distributed and contains numerous species, a few of which are rice pests. Their larvae are often provided with fine filamentous gills along the body, and to facilitate respiration under water such larvae are described as performing regular undulatory movements—as do *Chironomus* fly larvae.

Further literature on this group of moths is as follows:

Reamur, R. A. F. de. "Memoires pour Servir a L'Histoire des Insectes, Tome 2, Dixieme Memoire. Des Chenilles Aquatiques": 391-406, pl. 32, 1736. A species of *Potamogeton*.

Miall, L. C. "The Natural History of Aquatic Insects", 1895. Aquatic Caterpillars: 226-235, 1 fig. *Hydrocampa nymphaea* (Linn.), *Cataclysta lemnata* (Linn.), *Paraponyx stratiotata* (Linn.), etc.

Hampson, G. E. "Fauna British India", Moths, 4, 1896. On pp. 187-241, subfamily Hydrocampinae.

Hart, C. A. "On the Entomology of the Illinois River and Adjacent Waters", Bull. Ill. State Lab. Nat. Hist. 4(6), 1896, Lepidoptera on pp. 164-183 and 278, pls. 1 and 2. *Paraponyx obscuralis* Gr., *Hydrocampa oblitalis* Walk., etc.

Maxwell-Lefroy, H. and Howlett, F. M. "Indian Insect Life", 1909. *Nymphula depunctalis* Guen., p. 515-516; colored plate.

Needham, J. G. and Lloyd, J. T. "The Life of Inland Waters", 1916: 218-220.

Sison, P. "Observations on the Life History, Habits and Control of the Rice Caseworm, *Nymphula depunctalis* Guen." Philippine Jour. Agric., 9: 273-301, 4 pls., 1938. Also feeds on *Panicum* sp., *Paspalum* and *Eragrostis*. Life cycle, 21-37 days.

***Nymphula fluctuosalis* Zeller. (plate X).**

Zeller, K. Vet.-Ak. Handl.: 27, 1852.

"*Hab.* Throughout the tropical and subtropical zones, on the north to Formosa and Sandwich Islands, on the south to Australia". (Hampson, "Faun. Br. India" Moths, 4: 194, fig., 1896).

This moth occurs on the larger islands of the Hawaiian group. The earliest record of its presence here seems to be that given by Butler in May 1879 under the title: "On Heterocerous Lepidoptera collected in the Hawaiian Islands by the Rev. T. Blackburn", (Ent. Mo. Mag., 15: 270, 1878-9), the moth being under the name of "*Oligostigma curta*, n. sp." Following its description, Butler quotes Blackburn thus: "Not uncommon about grassy streams in mountain valleys, when such can be found, and that is seldom". It is a delicate whitish moth with fulvous bands on wings and abdomen. The wing expanse is from 16 to 21 mm.

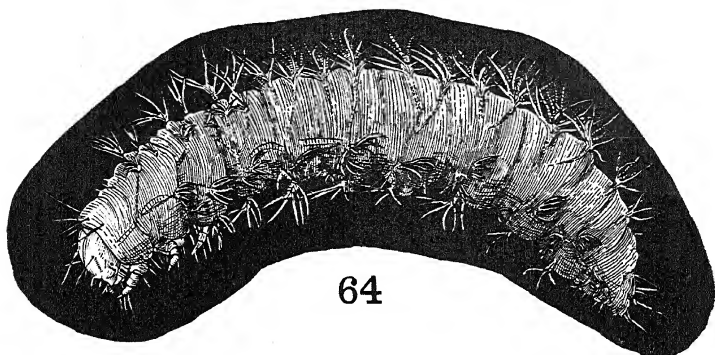
The caterpillar is a case-bearer, and when rice was extensively grown here was somewhat of a pest on that crop. It also feeds on other grasses, and Mr. O. H. Swezey once found it damaging the leaves of water lilies (*Nymphaea*) in Nuuanu valley, Honolulu, in September 1932. The moth is often taken at light. It lays a number of flattish, rather elliptical yellowish eggs a little more than half a millimeter long. The young larva has a pair of long hairs on the dorsum of the terminal segment and there are also some sparse shorter hairs. Later on it acquires dorsally and laterally on the body, fine filamentous gills enclosing air tubes that join the longitudinal tracheal trunks. The pupa is formed within a case or cocoon and is not extruded at the eclosion of the adult. The larva is sub-aquatic.

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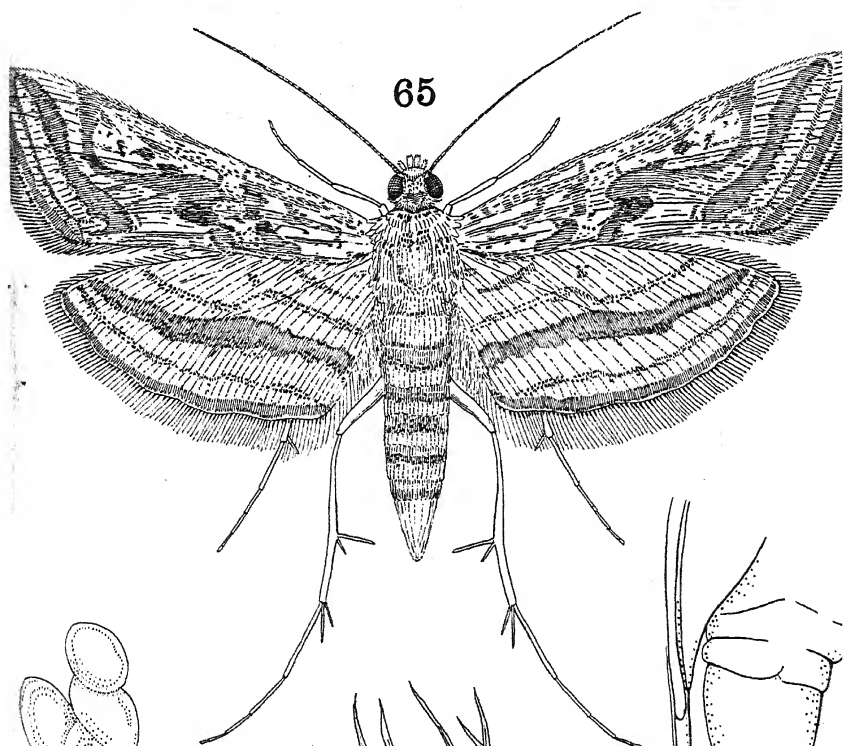
NYMPHULA FLUCTUOSALIS

Explanation of Plate X

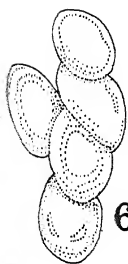
- 64. Larva, last instar.
- 65. Adult female. Expanse 17 mm.
- 66. Group of eggs.
- 67. A single dorso-lateral larval gill.
- 68. Pupa, caudal extremity, side view. Drawn from a dried specimen.



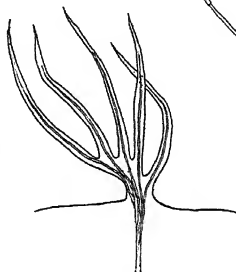
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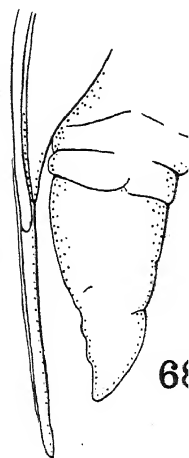
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67



68

***Nymphula oblitalis* (Walker). (plate XI).**

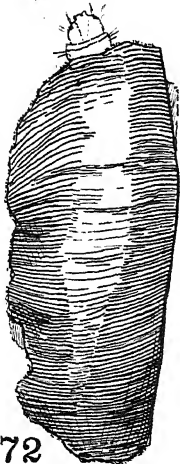
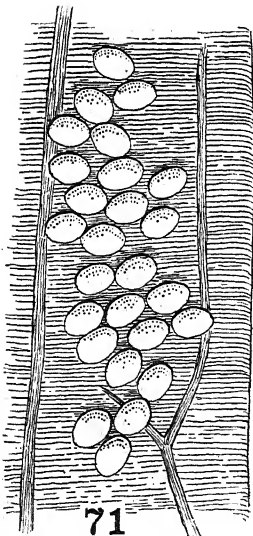
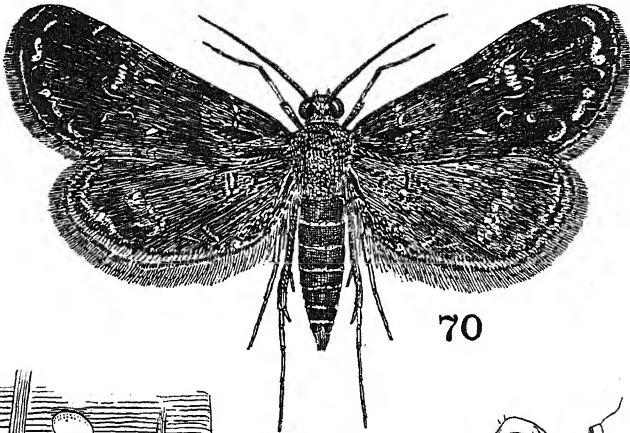
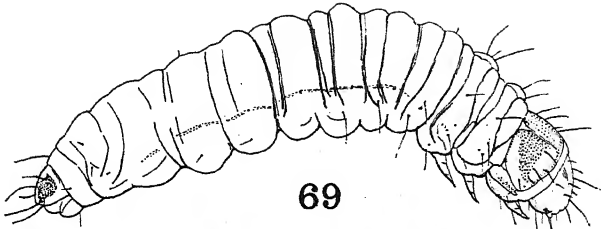
Walker, Cat. Brit. Mus., 17: 399. Described from Florida and Texas; rather widely distributed in the United States.

A duskier and heavier moth than *N. fluctuosalis*. It is a recent and unwelcome immigrant in the Hawaiian Islands, having been first reported by Mr. D. T. Fullaway who reared it from water lilies (*Nymphaea*) in Honolulu early in 1942. Later in the year it was reared by O. H. Swezey and by F. X. Williams. (Proc. Hawaiian Ent. Soc., 11: 277, 1943).

A group of eggs of this moth were found securely glued to the underside of a lily leaf close to the margin (fig. 71). They are low oval domes about 0.65 mm. long and of a whitish color. The larva at birth has a longitudinal tracheal system and some long simple hairs but does not later acquire filamentous gills (fig. 69). It does extensive though sporadic damage to lily leaves so that these become very ragged. It forms a case of pieces of the leaf and wanders about as a case-bearer, inflicting its unsightly damage also upon the flowers of the lily, and well merits the name "miserable sandwich worm" given it by my wife, copartner of a small lily pond. The larva also uses the leaves of other aquatic plants for making cases. A large larva 9 mm. long has a pale brown head, a darker narrowly fissate prothoracic shield and a dull pallid green body. The antennae are conspicuously porrect and there are sparse erect hairs on head and body. When under water the extruded fore part of the body dorsally, from the second segment, is beautifully silvered. The cocoon case is blunter at the fore end, and in issuing from it the moth makes a wide slit in the silk. In the laboratory the cocoon was securely fastened to the side of the glass container, just above the water line. The pupa has the spiracles on segments 2-4 of the abdomen large and protruding. For a good treatise on this insect the reader is referred to the work of C. A. Hart ("On the Entomology of the Illinois River and Adjacent Waters", Bull. Ill. State Lab. of Nat. Hist., 4(6): 174-180, and 278, plate II, Dec. 1895-April 1896). Hart writes, p. 176: "The favorite home of this species is among the floating leaves of *Potamogeton nutans*, which often thickly cover the surface of quiet water in large patches."

**NYMPHULA OBLITALIS****Explanation of Plate XI**

- 69. Larva, last instar.
- 70. Adult, a small, rather dark specimen. Expanse 11.5 mm.
- 71. Eggs on underside near margin, of *Nymphaea* leaf. Length of egg 0.65 mm.
- 72. Larva in case made of bits of *Nymphaea* leaf.
- 73. Pupa. Length 5.2 mm. Two views of second visible spiracle.





## PART V

## HEMIPTERA OR BUGS

Water-loving bugs are poorly represented in the Hawaiian Islands. They fall naturally into several groups according to structure and habits, as follows:

1. **Saldidae.** Shore-bugs. Found along the edges of streams and pools in the forest, on mossy banks, on the forest floor and along mountain trails. Several species. All endemic.
2. **Hebridae.** The hebrids. On mats of algae in reservoirs, on the edges of stagnant pools, etc. Chiefly in the lowlands. A water-running bug, often submerging. One species. Immigrant?
3. **Mesoveliidae.** The mesoveliids. Active water-runners, but favoring algal mats, leaves of water plants and the edges of sluggish streams. Chiefly lowlands. One species. Immigrant.
4. **Gerridae.** In our case, pelagic water-striders. Offshore or open ocean. Two species. Endemic or indigenous.
5. **Veliidae.** The veliids or broad-shouldered water-striders. Active; widespread; reservoirs, sluggish streams, puddles, large artificial water containers. Favors algal mats, floating debris, etc. One species. Immigrant?
6. **Notonectidae.** The back-swimmers. Living in the water, reservoirs, ponds, pools in the forest, water troughs, etc. One species. Presumably immigrant.
7. **Corixidae.** The water-boatmen. Inhabiting chiefly the bottom of pools, in our case, preferably saline. One species. Not known elsewhere.

## FAMILY SALDIDAE (text figure 8)

Our *Saldula* are broad little bugs from about 3 to 6 mm. long, brownish to black but with the hemelytra marked with pale window-like spots and dashes. The wings—under the hemelytra—may range from mere stubby rudiments to nearly or quite the length of the hemelytra. They are very active, hopping and running and some are able to fly a short distance. Five species and one variety are listed by Kirkaldy (Fauna Hawaiiensis, 3 (2): 146, 1908, and

t.c., pt. ibid 2 (6) : 554, supplement to Hemiptera, 1910) under the genus *Acanthia*, as follows:

*Acanthia exulans* (F. B. White).

*Acanthia oahuense* (Blackburn).

*Acanthia oahuense* (Blackburn), var. *molokaiensis* Kirkaldy.

*Acanthia humifera* Kirkaldy.

*Acanthia nubigena* Kirkaldy.

*Acanthia procellaris* Kirkaldy.

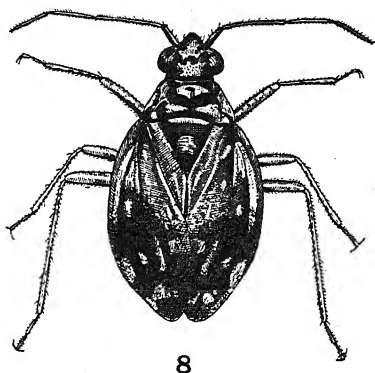


Fig. 8. *Saldula* sp., Hering valley, Honolulu. Enlarged.

This group however, is recognized as being badly in need of revision. In addition to the environment already mentioned, Dr. R. C. L. Perkins has upon occasion found *Saldula* to be to some extent arboreal (Fauna Hawaiiensis, 1 (6), Introduction: cciii, 1913). Practically nothing has been published as yet on the developmental stages of our species. Dr. R. L. Usinger has succeeded in rearing an Oahuan *Saldula* from egg to adult (Proc. Hawaiian Ent. Soc., 9: 359, 1937).

Although *Saldula* can easily maintain itself upon the surface of the water, it seems unwilling to do so and quickly makes for shore. It is carnivorous in its habits, and I have seen it in Manoa valley probing algal covered boulders for the larvae of Tipulidae or crane-flies.

#### FAMILY HEBRIDAE

**Merragata hebroides** White. (text figure 9).

White, F. B., Ann. and Mag. Nat. Hist. (IV) 20: 114, 1877.  
 "On small stagnant pools formed by the temporary overflow of

streams on the higher mountains. When the pools dry up, the insect frequents the holes where the water has been."

This is a compact little bug about 2 mm. long. It is rather leisurely, even tedious in its movements, and its short water-skimming flights do not suggest much energy. *Merragata* is a common

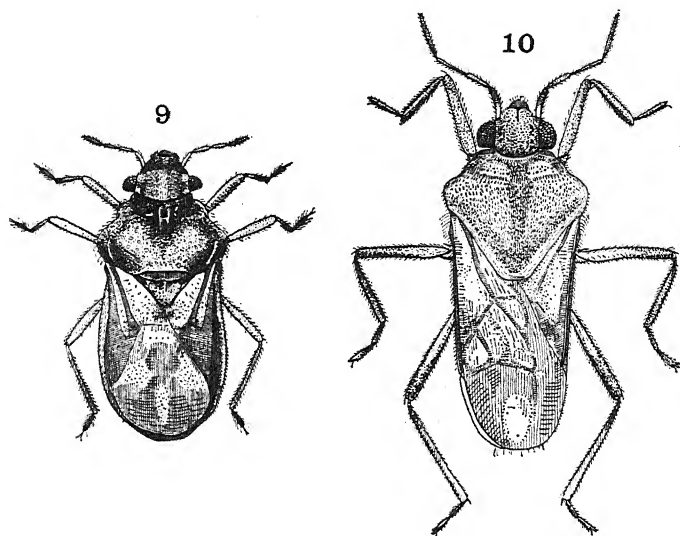


Fig. 9. *Merragata hebroides*. Length 2.20 mm.

Fig. 10. *Microvelia vagans*, alate form.

insect at puddles, along stagnant portions of streams and in reservoirs, occurring there on algae and algal blankets. Both young and mature bugs readily pull themselves under water, where they become conspicuous because of their air-silvered bodies. They may remain submerged for some time. In the laboratory one was seen sucking the juices of an immature one of its own kind that still showed signs of life. And here it was preyed upon by *Mesovelia vagans*, a larger water surface bug.

#### FAMILY MESOVELIIDAE

***Mesovelia mulsanti* White.** (text figures 11, 12 and 13).

White, F. B. Trans. Ent. Soc. London, 1879: 268. "Hab. Rio Purus (September 24, 1874)". Amazons. Determined by Dr. H. B. Hungerford.

This slender active bug is 3-4 mm. long and of a generally yellowish green color. Adults may be winged or entirely apterous.

The winged form is the more slender and the ocelli are well developed. Its partly whitish wings render it rather conspicuous on its home of blankets of algae or on the leaves of aquatic plants. The apterous form has a wide suboval body while the ocelli are obsolescent.

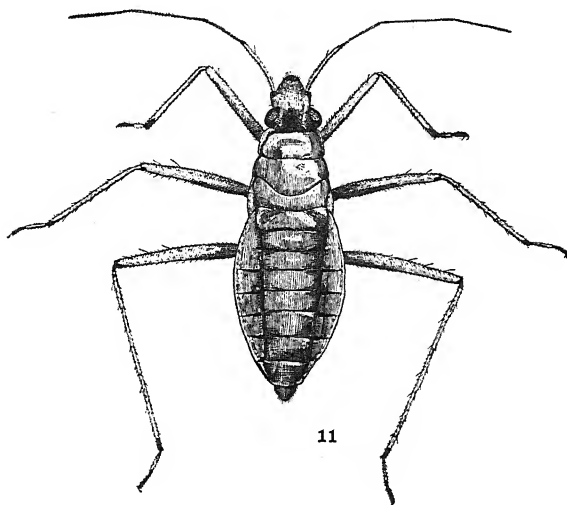


Fig. 11. *Mesovelia mulsanti*, apterous form.

Although the first record of the presence of this widespread American insect in Hawaii appears to be in 1933 (Proc. Hawaiian Ent. Soc., 8: 378-379, 1933), when it was taken in a reservoir at Waipio substation, Oahu, it had probably been here for some years previous. It soon appeared in lily ponds and made its way into the mountains where it keeps to the sides and vegetation of the quiet stream pools.

Its biology was little studied. In New York and in Kansas, Hungerford ("Aquatic Hemiptera". Kans. Univ. Sci. Bull., 11: 101-106; pl. XIV) gives a good account of this insect, the activities of which he studied under a binocular microscope. The insect is found upon floating vegetation and feeds upon the small organisms that come to the surface from below, or that fall upon it. Entomostaca (Crustacea) were thus speared at the surface of the water. The eggs are imbedded in the tissue of certain plants.

Pieces of algal mats, composed largely of *Hydrodictyon*, from a lowland reservoir on Oahu were brought to the laboratory and placed in a jar of water. Little *Merragata* bugs and the active young of *Mesovelia* were found in it. Eventually, a young *Meso-*

*velia* was observed in this jar with an immature *Merragata* skewered on its beak. Although rather chary of the adults of this little bug, *Mesoveliea* often pounced upon a young *Merragata*, sometimes holding it down with aid of a foot or grasping it loosely with the legs and probing it for a deadly thrust. Or, *Mesoveliea* would use only its beak for the attack. The thrust was sometimes made in a leg joint and sometimes in the body itself; in any case *Merragata* collapsed almost immediately, folding up its legs. It would then be held aloft to be sucked of its juices.

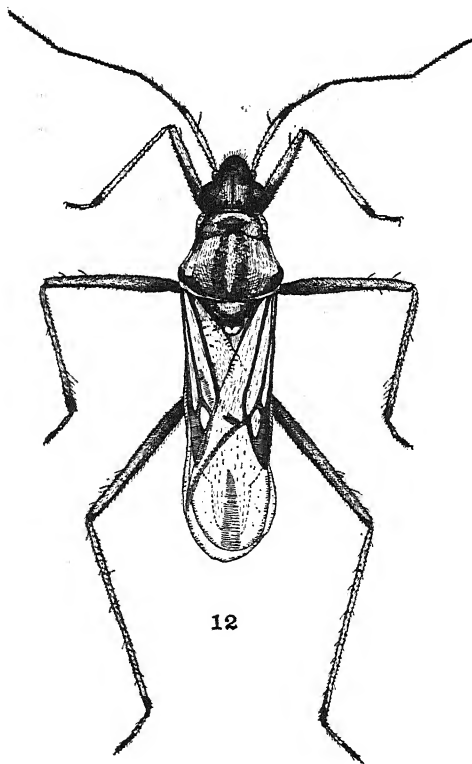


Fig. 12. *Mesoveliea mulsanti*, alate form.

#### FAMILY GERRIDAE

There are no fresh-water striders of this family in the Hawaiian Islands. The pelagic water-striders are medium sized, entirely wingless insects, more or less grayish in color, with stout streamlined bodies and the middle pair of legs hair-fringed apically and

developed for great speed. They are common about tropical shores though also represented in temperate zones. They frequent lagoons and estuaries but may also be found far out at sea. Two species inhabit the Hawaiian area. The bather at Waikiki beach may have observed these insects as they speed over the surface of the water before him and occasionally executing a leap of an inch or two into the air. Certain inshore storms drive these insects in wind-rows along our beaches (Hadden, F. C., Proc. Hawaiian Ent. Soc., 6: 457-459, 1 fig., 1931).

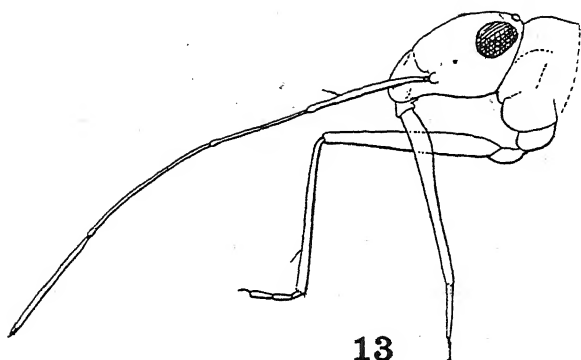


Fig. 13. *Mesozelia mulsanti*, profile of head.

It has been stated by some writers that *Halobates* can and does dive beneath the surface of the water; this faculty would then be useful in avoiding the full force of storms. Dr. R. L. Usinger who has devoted considerable study to these insects was unable to induce *Halobates* to dive beneath the surface ("Biological Notes on the Pelagic Water Striders [*Halobates*] of the Hawaiian Islands, with Description of a New Species from Waikiki [Gerridae, Hemiptera])"; Proc. Hawaiian Ent. Soc., 10: 77-84, 3 figs., 1938). I myself doubt that these insects do any diving and believe that many *Halobates* frequently perish in storms, as would likewise a certain proportion of other organisms under adverse conditions in nature.

Eggs of *Halobates* have been found on objects floating in the ocean in other parts of the world. Very young bugs may be observed along the seashores of Oahu.

Dr. Usinger found *Halobates* under captive conditions to be fiercely cannibalistic.

The two species found in Hawaiian waters are *Halobates hawaiiensis* Usinger (l.c., : 79-82) and *Halobates sericeus* Eschscholtz (Entomographien, 1: 108, tab. II, fig. 4, 1822). Dr. Usinger

found that *H. hawaiiensis*, characteristically gregarious, keeps within the protecting reef; *H. sericeus*, on the other hand is characteristic of the open ocean between the various islands. It is also listed from the Atlantic Ocean.

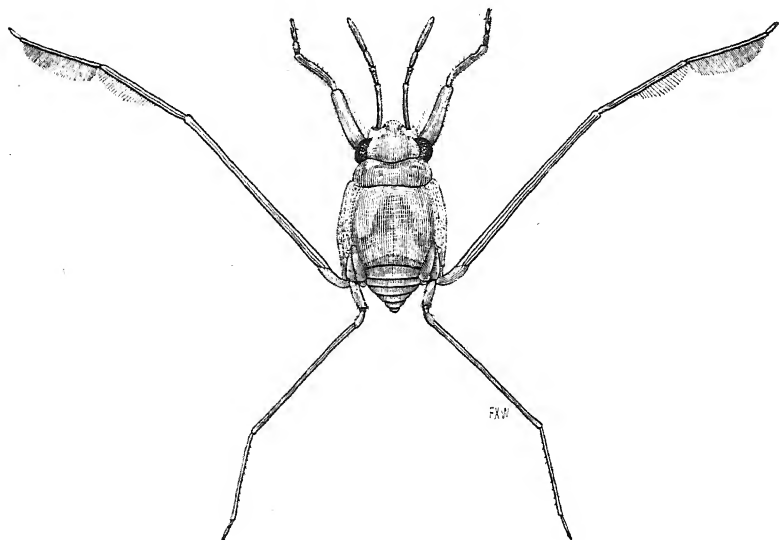


Fig. 14. *Halobates sericeus*. (After Hadden.)

#### FAMILY VELIIDAE

***Microvelia vagans* White.** (text figure 10).

White, F. B., Ann. and Mag. Nat. Hist., (V) 1: 374, 1878.

This very common little bug is widely distributed in the Hawaiian Islands. It measures about 2.3 mm. long and is represented by both apterous and winged forms. It can be found on stagnant pools, taro ponds, lily ponds, the edges of sluggish streams where there is plenty of algal growth, and even in street gutters in wet districts. It will also find its way into tanks and other large water containers. It is not always on the surface of the water but patronizes the wet leaves and rocks nearby. A fiercely predaceous insect, *Microvelia* gangs up on chironomid flies as these emerge from their pupae at the surface of the water, and may overcome crane-flies issuing from some moss or algal growth. In the cool Mountainview region of the island of Hawaii, in October 1933, I witnessed successful attacks by *Microvelia* on the large pale, dark spotted collembolan, probably *Salina*, that so often finds its way into pools with steep banks. *Salina* is an active leaper upon the surface of the water, nevertheless the bug succeeds in stabbing it in the back, or

it would rush at it from the side. Once stabbed, *Salina* immediately collapsed. The presence in this pool of many dead and sucked-out *Salina* attested to the success of *Microvelia*. Many podurans of lead color were also found dead here, although they did not appear to have been fed upon.

*Microvelia* lays her eggs on dead leaves in pools, or elsewhere in the wet. The tiny red young may show silvery bubbles of air within the body, and a recently hatched individual clinging submerged to a leaf was observed with its proboscis at the surface, adding bubbles to its supply.

A good biology of *Microvelia borealis* Bueno is given by its describer in Ent. News, 28: 354-359, 1 pl., 1917.

### FAMILY NOTONECTIDAE

The backswimmers are represented in the Hawaiian Islands only by the foreign *Buenoa pallipes* (Fabricius, Syst. Rh.: 103, 1803), (text figure 15), an insect that is commonest in the lowlands but ranges into our mountains to several thousand of feet altitude. It is a pale shining insect with some reddish; well streamlined, and the posterior legs developed for rapid oar-like strokes. The two anterior pairs of legs are relatively small and generally hidden when the insect is viewed from the dorsal side. These legs function as baskets in which to hold an armful of food; to quote Hungerford relative to the food habits of *Buenoa margaritacea* Bueno, a species common on the mainland of the United States (Kansas Univ. Sci. Bull., 11 (17): 194-195, 1919) "*Food Habits*. One striking point in their biology is the adaptation of their two slender anterior pairs of limbs to food getting. The food of these insects of the small entomostracan Crustacea, and the four anterior limbs are margined with rather long spines which form when flexed a splendid crib for the retention of these little animals". Hungerford goes on to say: "They sometimes attack other insects, such as Corixids, but rely almost exclusively upon the little organisms named."

*Buenoa* while rising from time to time to the surface to renew its air supply, habitually keeps some inches below the surface, maintaining its position there by timely strokes of the posterior legs. Some of our lowland reservoirs teem with tiny crustacea, a *Daphnia*-like species for example being found in veritable clouds some distance beneath the surface. Ostracoda may also abound. Here *Buenoa* thrives. A particularly fine habitat for this bug was discovered many years ago at Haleiwa, Oahu. There on the flat lowlands was a shallow marshy pond already encroached upon by reeds,



succulent *Herpestis* (Scrophulariaceae), etc. It swarmed with small aquatic life. *Buenoa pallipes* (Fabr.) was present in all stages; *Arctocorixa*, *Merragata* and *Microvelia* abounded; here and there were *Enochrus nebulosus* (Say), a small hydrophilid beetle; the nymph of the endemic lowland damselfly, *Megalagrion xanthomelas* Selys, quantities of the common *Anax junius* Drury dragonfly and veritably swarms of *Pantala flavescens* (Fabr.), our abundant brown dragonfly. In addition, there were plenty of bloodworms (Chironomidae) and smaller organisms.

In captivity *Buenoa* quickly killed and fed upon the larvae of mosquitoes.

The males of *Buenoa* possess the power of stridulation; in *B. pallipes* the sound produced resembles the fine ticking of a watch, or the stridulation of certain small species of locustid grasshoppers,

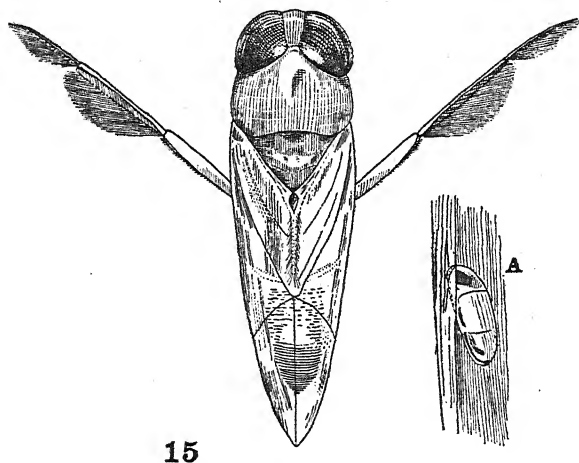


Fig. 15. *Buenoa pallipes*; A, egg embedded in plant tissue.

and it is audible from a distance of several feet. This sound is produced "When the fore limbs are brought up to the head, it will be seen that the stridular areas of the limbs meet those on the base of the beak". (Hungerford, l.c., re *B. margaritacea*).

The eggs of our *Buenoa* were found imbedded in plant tissues.

Unlike *Arctocorixa* in Hawaii, *Buenoa* seems quite unable to endure salt water.

## FAMILY CORIXIDAE (The Water Boatmen)

*Arctocorixa blackburni* (White). (text figure 16).

White, F. B., Ann. and Mag. Nat. Hist., (IV) 20: 114, 1877; ibid (V) 1: 366, 1878. (*Corixa blackburni*) Kirkaldy, G. W., Fauna Hawaiiensis, 2 (6): 554, 1910. (*Arctocorixa blackburni*).

Of this insect, Dr. R. C. L. Perkins says (Fauna Hawaiiensis, 1 (6), Introduction: cciii, 1913): "This family is represented only by *Corixa blackburni* White, a species not known from elsewhere. It is very widely distributed on the lowlands of the islands, inhabiting salt-water pools as well as ponds of fresh water. It comes to light at night sometimes in considerable numbers."

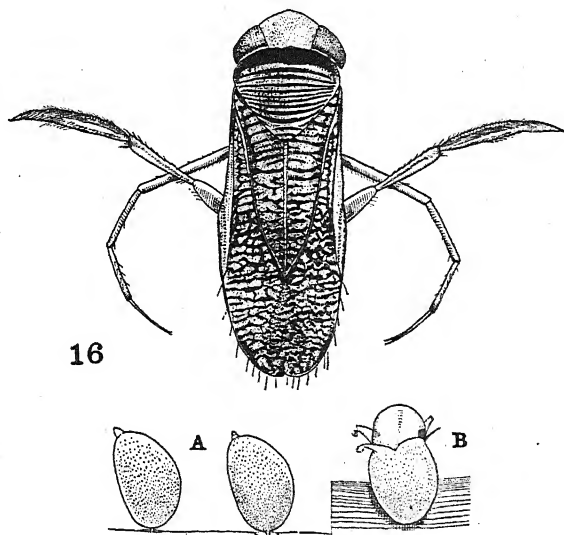


Fig. 16. *Arctocorixa blackburni*; A, eggs; B, young hatching from egg.

Our water boatman measures about 4.5 mm. long. The back of the thorax is finely banded with blackish while the elytra are finely but irregularly banded with brownish to black. The long posterior legs are hair fringed for propulsion by swift strokes.

Although the water boatman has been taken in a clear stream at over 2000 ft. elevation on Molokai, I have found it numerous only in the lowlands. It may fairly swarm in salty pools separated from the ocean by a low sandbar and having a salinity of approximately 5 per cent, or saltier than the sea itself. In this same salty medium we may find *Enochrus nebulosus*, the hardy little hydro-

philid beetle. *Arctocorixa* also thrives in lowland ponds on a base of mud and coral and where the water is fresh or nearly, and well stocked with other aquatic insects. The bug seems not to suffer from the presence of small fish that share the pool. It is a bottom insect, coming to the surface only for air or to take flight. I have seen swarms of this insect, nearly all immature, swimming steadily and mainly in one direction in a salty pool by the sea beach. The short-stemmed eggs are secured to submerged algae or other available material; they may be present in great quantity and appear like little white beads. I have kept *Arctocorixa* in sea water for over two weeks, and have seen a single individual at Waikiki swimming and diving in shallow water about 130 feet out from the shore.

It is probably chiefly herbivorous, as Hungerford has shown for other species (Kansas Univ. Sci. Bull., 11, Aquatic Hemiptera, 234-249, 1919).

Our corixid often takes flight in the daytime. It would seem that the shining surface of water attracts *Arctocorixa*, and we have seen them in the bright sunshine crashing against the polished hood of an automobile, evidently mistaking the shining metal for their proper element.

Corixidae produce a chirping sound much as do the Notonectidae.

## ADDENDA

Since commencing these papers on Hawaiian water-loving insects, other aquatic or subaquatic insects have appeared in the Territory, or have been overlooked. The following are now listed:

### Order COLEOPTERA

#### Family CURCULIONIDAE

##### *Stenopelmus rufinasus* Gyllenhal.

Mr. E. C. Zimmerman has the following to say regarding this small robust insect:

"Four specimens of this semi-aquatic weevil were collected by Dr. H. Lyon from *Azolla* at Honolulu, in November 1909. It has remained undetermined in the Sugar Planters' collection and has evidently not been collected since that time. It may not have been established here, but it is worthwhile to record it. Its small size and peculiar biology, however, may have kept it hidden from collectors. . . ." (Proc. Hawaiian Ent. Soc., 10: 131, 1938). It is widely distributed in the United States.

Order **TRICHOPTERA**  
Family **HYDROPTILIDAE**

***Oxyethira* sp.**

This interesting find was made by Mr. E. C. Zimmerman in October, 1940, in Moanalua Gardens, Honolulu. (Proc. Hawaiian Ent. Soc., 11: 350-352, 1943). He collected "a series of a minute, moth-like insect flying about at noon day near the banks of a small garden stream and nervously running about on the bare ground and searching into cracks in the soil. . . ." "The species is evidently not American, and is unknown to Nathan Banks, who kindly examined it. . . ." "It is probable that this species of *Oxyethira* has gained entrance to Hawaii by accompanying imported aquatic plants. . . ."

Order **ODONATA**  
Suborder **ZYGOPTERA**  
Family **COENAGRIONIDAE**

***Enallagma civile* Hagen.**

This is a small damselfly, the male with the abdomen blue with black bands, the female of duller coloration, the abdomen being somewhat grayish. This insect was so outstandingly distinct in facies from our own fine species that it was immediately recognized as an intruder in the Hawaiian odonate fauna. The first record of its capture here is July 4, 1936, when a male specimen was taken on a hillside in Manoa valley, Honolulu (Proc. Hawaiian Ent. Soc., 9: 368, 1937). It soon became very abundant in Honolulu and appeared on some of the other islands. It is common about reservoirs, lowland swamps and other bodies of water and may be seen in numbers in waste places and in gardens where there are no breeding places for it apparent. We find it also on the summits of mountains behind Honolulu.

***Ischnura posita* (Hagen).**

Mr. Charles Hoyt of Honolulu first found this very small damselfly here. It was breeding in the Punahou School lily pond, Honolulu (Proc. Hawaiian Ent. Soc., 9: 370, 1937). It is now an abundant insect. It is common on the mainland of the United States. Our specimens were determined by Mr. John Cowley.

These two damselflies are probably of some economic importance as destroyers of mosquitoes. They gained entrance into the Hawaiian Islands presumably through the importation of aquatic plants.



## A Case of Bovine Auricular Myiasis and Some Ectoparasites New to Hawaii

BY ELWOOD C. ZIMMERMAN

Entomologist, Bernice P. Bishop Museum

(Presented at the meeting of September 13, 1943)

On August 16, I attended an autopsy of a cow at the animal quarantine station in Honolulu for the purpose of searching for ectoparasites. The animal, which was in a run down condition, had been brought from the island of Molokai by the Territorial Veterinarians Dr. Willers and Dr. Hendershot for study of an apparent nutritional disease. The cow was butchered immediately after being shot. When the rumen was opened, I saw a full grown fly maggot crawling about in the food-mass. Upon searching for the source of the maggot, it was found that the animal's ears were packed with writhing masses of hundreds of fly maggots ranging in age from young to mature individuals. The maggot found in the rumen had evidently been licked up and swallowed by the cow. One of the ears was cut off, and some of the maggots from each ear were brought back to the laboratory. In due course, 275 *Chrysomya megacephala* (Fabricius) and 39 *Chrysomya rufifacies* (Macquart) adults were reared. In addition to this reared material, I saw a few larvae of a species of *Fannia* when the slaughterer cut open one of the ears and threw out a mass of maggots with his knife. Unfortunately, the *Fannia* material was lost.

A few days before killing the animal, Dr. Hendershot, who was responsible for my being present at the autopsy, removed a series of ticks from the cow's ears. I have identified the ticks as the argasine *Ornithodoros megnini* (Dugès), the spinose ear tick. There were other specimens of the tick present in the ears when I examined them. Perhaps sores developed in the ears after the ticks were removed and these sores were struck by the flies.

During the rearing of the *Chrysomya* species, three specimens of the fly *Discomyza maculipennis* (Wiedemann) (Ephydriidae) were reared. In spite of the precautions taken to prevent contamination of the culture, it is probable that the ephydrid gained entrance to the jar containing the ear and was not present when the ear was removed from the cow. However, I cannot be certain of this. This ephydrid has previously been reared only from dead sea shells in Hawaii and little is known of its biology.

During the preparation of my manual "Insects of Hawaii", I have collected or identified several species of ectoparasites which have heretofore apparently not been mentioned in Hawaiian literature. Some of these are now placed on record for the convenience of local workers.

I understand that the spinose ear tick mentioned above has been found on Oahu, Molokai, Maui and Hawaii.

A mite which has caused some trouble to human beings, and which has been lately studied by Mr. Pemberton and me, has been identified by Dr. Ewing as *Liponyssus bursa* (Berlese), the tropical fowl mite. We have found the mite common in the nests of English sparrows and mynah birds. Honolulu physicians have reported several cases of mite bite irritation resulting from the invasion of houses (especially bedrooms) by this minute mite. The mites can blow through ordinary screen from nests under the eaves of dwellings.

The sucking louse *Polyplax spinulosus* (Burmeister) has not been listed from the Territory, but I have seen specimens collected from rats in Honolulu.

I collected the sucking louse *Linognathus africanus* Kellogg and Paine from goats at Kahala, Honolulu in May, 1943.

The biting louse *Gliricola porcelli* (Linnaeus) was collected from Guinea pigs in Honolulu in June, 1943.

The cow discussed above was heavily infested with the biting louse, *Bovicola bovis* (Linnaeus).

In 1920, Mr. Swezey collected *Bovicola caprae* (Gurlt) from a goat in Honolulu.

I have examined specimens of the biting louse *Felicola subrostrata* (Nitzsch) at the Hawaiian Sugar Planters' Experiment Station taken from cats in Honolulu.

The biting louse *Columbicola columbae* (Linnaeus) was recently collected from pigeons in Honolulu.

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### Pembertonia, A New Genus of Papuan Cossoninae (Coleoptera, Curculionidae)

BY ELWOOD C. ZIMMERMAN

Entomologist, Bernice P. Bishop Museum

(Presented at the meeting of December 13, 1943)

To those who study the enormous family Curculionidae, or weevils, the seemingly endless array of forms and structural diversification becomes ever more remarkable and overwhelming. Peculiar

new species and genera still come to hand much faster than the overburdened taxonomists can possibly make them known to science. In spite of the fact that about 40,000 species have been described, the family is poorly known. There yet remain vast areas of the tropical world where most of the thousands of species are unknown. The difficulties of treating these myriads systematically need hardly be emphasized, and the amazing morphological diversity makes the task appear, at times, hopeless. The very characters which have long been used to separate genera and supra-generic categories have broken down time and time again, even in groups which we have long thought to be well characterized and stable. One is at a complete loss to anticipate what revolutionary new forms may come to light when the fruits of arduous field work are examined under the microscope. Mimetic-like forms may be assigned to certain genera after cursory examination, only to be found after detailed study to belong to widely separated subfamilies. Other forms which appear certainly to belong to different subfamilies prove to be only confusing members of a single genus. For these and other reasons, our literature for about the past 80 years has been largely devoted to recording and descriptive work, and comparatively little has been done on the larger problems of supra-generic classification. Because of the difficulties of the task, there are no synoptic diagnoses nor keys to the more than 70 subfamilies now recognized in the world. It is true, however, that there are local works which partially cover the comparatively impoverished European or North American faunas, but there is no world-wide monograph to aid the floundering worker. The great Schoenherr treated all the genera and species known to him a century ago—it took about 15 years of concerted effort on the part of him and his several collaborators to fill the several thousand pages of his *opus*. Today, a similar accomplishment is impossible.

This paper is written to place on record a strange new genus which I assign to the Dryophthori of the Cossininae. We have come to believe that the Dryophthori form a compact and distinct group which is peculiar in that its members have the tarsi 5-segmented, whereas the normal compliment in the Curculionidae is four. However, this new creature has all the essential attributes of the Dryophthori, yet the very character which signalizes that group is wanting, for it has 4- instead of 5-segmented tarsi! In spite of this structural anomaly, the insect is otherwise a typical dryophthorid, and to separate it from its obvious allies would be gross error.

It is with much pleasure that I dedicate the genus of this remarkable new weevil to its collector, Cyril E. Pemberton, Executive Entomologist, Hawaiian Sugar Planters' Experiment Station, an



economic entomologist who keenly appreciates the values of pure scientific research to the applied fields of his endeavor.

### **Pembertonia**, new genus

*Body* *Dryophthorus*-like in form, sculpture and vestiture; luteose, dorsal vestiture sparse and velutinous.

*Head* with crown exposed from above; interocular area narrower than base of rostrum; eyes largely lateral, coarsely faceted, subcontinuous in outline with head.

*Rostrum* subcylindrical, longer than head, but not as long as pronotum; scrobes invisible from above, beginning behind middle and passing rapidly to under side.

*Antennae* with scape reaching only to fore edge of eye, longer than funiculus excluding club, funiculus 4-segmented, first two segments larger than distal two; club about as long as funiculus, mostly shiny and sparsely pubescent except for apex which is densely pilose (apical half conspicuously, obliquely truncated on genotype, but this may not prove to be a generic character).

*Prothorax* well developed, base convex, subapically constricted; post-ocular lobes absent.

*Scutellum* small, inconspicuous.

*Elytra* with distinct humeri, broader than prothorax, distinctly 10-punctate-striate.

*Wings* developed for flight.

*Legs* with femora not distinctly clavate, unarmed, not grooved beneath, hind pair reaching about to apex of elytra; tibiae comparatively straight, with a strong terminal uncus, but not mucronate, longitudinally carinate; tarsi 4-segmented, the true fourth segment invisible, first three segments pilose, the third entire at apex, fourth segment slender, elongate, bare; claws small, slender.

*Sternum* with anterior margin of prosternum emarginate at middle, much longer in front of than behind fore coxae; fore coxae contiguous; mesosternum sloping; mesocoxae separated by much less than breadth of a mesocoxa; metasternum about as long along median line as first two ventrites, distance between inner margins of metacoxae nearly equal to distance between outer edges of mesocoxae, outer edges of metacoxae very nearly touching elytra; met-episternum invisible.

*Abdomen* with ventrite I longer than II plus III along median line, on a plane distinctly ventrad of that of the remainder of abdomen; intercoxal piece subtruncate, but with an anterior median projection; ventrite II sloping, longer than III plus IV; ventrites IV and III narrow, together about as long as V.

Genotype: *Pembertonia seftoni*, new species.

This genus resembles *Dryophthorus*, but it can be distinguished principally because of its four-segmented rather than pentamerous tarsi and its contiguous fore coxae. Other characters which may prove to be useful as generic distinctions are the peculiarly oblique apex of the antennal club, the scape not passing behind the fore margin of the eye, and the fact that the hind edges of the eyes are narrowly hidden beneath the edges of the prothorax, although these latter characters may be subject to variation.

With the discovery of this aberrant genus, the possibility is brought forward that perhaps future collecting and study will reveal a number of variformed genera which are centered around *Dryophthorus* in addition to the few thus far known.



Fig. 1.

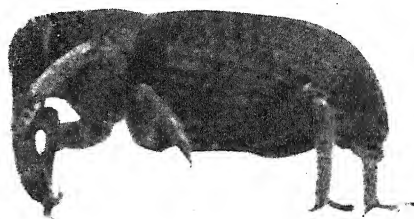


Fig. 2.

Figs. 1 and 2.—Dorsal and lateral views of holotype of *Pembertonia seftoni*, new genus and species (photographs by W. Twigg-Smith, courtesy of Hawaiian Sugar Planters' Association).

***Pembertonia seftoni*, new species (figs. 1-4).**

Female. *Color*: derm coal-black, almost completely alutaceous and dull; tarsi piceous; vestiture gray and brownish-gray; incrustation brown.

*Head* with crown broadly convex, evenly set with well separated, medium sized, round punctures, the interstices as broad or broader than the punctures, without distinct setae; interocular area with a distinct median depression between dorsal edges of eyes, narrowest distance between eyes two thirds breadth of base of rostrum; eyes five facets broad at middle, about twice as high as broad, as widely separated beneath as breadth of base of rostrum, lower edges narrowly concealed by prothorax.

*Rostrum* about nine tenths as long as pronotum, arcuate, almost cylindrical, subequal in diameter at base, at antennal insertion and at apex; densely punctate from base to apical fifth, punctures toward sides subconfluent or confluent; punctures with the peculiar dryophthorid velutinous vestiture, which is longest and densest on sides beyond antennae; apical fifth bare, impunctate, moderately shiny, with a broad, shallow, rather obscure, median, apical impression; ventral surface with a prominent median carina from base nearly to oral cavity and flanked on either side by a narrow, incrustation-filled or pilose sulcus, and scrobes distinctly impressed beneath.

*Antennae* inserted at about basal two fifths of rostrum in female holotype; scape stout, clavate, about as long as funiculus plus one half length of club, as thick at widest part as length of funicular segments III plus IV; funicular segment I as broad as, but somewhat longer than II, rounded at apex, II subtriangular, about as long as broad, as long as III plus one half of IV, apex truncate, III and IV transverse and twice as broad as long; club about as long as funicular segments I and IV, three fourths as broad as long,



Fig. 3.



Fig. 4.

Figs. 3 and 4.—Outline diagrams of antenna and tarsus of *Pembertonia seftoni* Zimmerman.

obliquely cut off on side toward scape for nearly one half its length at a 45-degree angle, the truncated area densely pilose, elsewhere with scattered prostrate setae.

*Prothorax* nearly as broad as long (25:27 units in holotype), broadest very near base, and there hardly broader than at hind edge of subapical constriction (25:24 units in holotype), sides straight from base to hind margin of subapical constriction; subapical constriction abruptly incised, situated at about apical fifth of side as viewed from above, but extending obliquely caudad toward disk, not distinctly continued across dorsum, but marked on sides and sternum; longitudinal dorsal contour slightly, almost evenly convex; punctures large, rounded, distinctly smaller cephalad of subapical constriction, capped with thin, brown, parchment-like incrustation, but punctures beyond subapical constriction with velutinous vestiture, setae inconspicuous, intervals narrower than punctures.

*Scutellum* inconspicuous, much smaller than an adjacent prothoracic puncture.

*Elytra* fully three fourths as broad as long, somewhat more than twice as long as prothorax, broadest between humeri and middle, breadth across humeri about one and one half times as broad as base of prothorax; base broadly emarginate; humeri prominent and at angles of about 45 degrees; sides convergently arcuate to near apex where there is a distinct break in the contour caused by subapical constriction and a small tuberculiform process situated at position where intervals III to IX would join if extended; striae well and regularly marked, but not impressed between punctures, punctures subquadrate and similar in size to those on disk of pronotum, broader than intervals, stria IX joining X above metacoxa, setae inconspicuous; alternate intervals, especially I, III and V, appearing slightly more elevated than others, and I, III and V with almost continuous velutinous vestiture, vestiture of other intervals arranged in small spots, without distinct setae.

*Legs* with femora densely set with moderately coarse punctures bearing conspicuous compound setae or velutinous pile; tibiae densely clothed with rather matted pile, with the longitudinal carinae showing through; tarsi with segments I to III clothed with short velutinous pile with longer setae beneath, IV bare, segment I about as long as II plus one half of III, about one third longer than broad, II about as long as broad, somewhat shorter than III, III slightly longer than broad, as broad as II, IV as long as II plus III, imbedded nearly to middle of III and about one half as broad as III.

*Sternum* with anterior prosternal margin so emarginate that distance on median line from anterior margin to ventral extension of subapical constriction of prothorax is only about one third or less that on side as viewed from directly beneath, area in front of coxae sloping strongly upward, coarsely punctured, distance behind coxae hardly one fourth length of a fore coxa; mesosternum subtuberculiform between mesocoxae and at a level distinctly ventrad of that of metasternum, without conspicuous punctures at sides above

coxae, sutures of side pieces obscure; metasternum with punctures of disk rather small, separated by one and one half to more than twice their diameters, punctures along fore margins and at sides larger.

*Abdomen* with ventrite I tumid in female holotype, with a row of large marginal punctures, but those on disk similar to those on disk of metasternum; ventrite II with a row of dense, coarse punctures along fore margin and a well separated row at about middle; ventrites III and IV with their bounding sutures unusually broad, coarse and deep, sulciform, the sutures ending in marginal punctures and thus appearing to be turned slightly backward at sides, the ventrites costiform, with small punctures; ventrite V coarsely sculptured, subapically setose; pygidium shallowly impressed down middle, apex subtruncate.

Length (excluding head) : 4.0 mm.; breadth : 1.9 mm.

New Guinea. Holotype female, stored in the type collection of Bishop Museum, collected by Cyril E. Pemberton at Koitaki at 1,500 feet elevation in November or December 1928. (Koitaki is in a wet district about 30 miles into the mountains from Port Moresby on the Laloki River.)

This species, which appears to be a *Dryophthorus* at first sight, probably has habits similar to *Dryophthorus*, and future collectors may find it under damp, rotting bark or in rotting wood.

At Mr. Pemberton's request, I have dedicated this species to T. L. Sefton, manager of Koitaki Rubber Estates, Ltd., Papua, in appreciation of his cooperation and aid to the field researches of Mr. Pemberton, and on whose plantation it was discovered.

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## Two New *Amblycnemus* from Larat Island (Coleoptera, Curculionidae)

BY ELWOOD C. ZIMMERMAN

Entomologist, Bernice P. Bishop Museum

(Presented at the meeting of December 13, 1943)

In 1931, Sir Guy Marshall described the anthonomine genus *Amblycnemus* to receive a Samoan species, and since then several other species have been described. Although many new species await description in the collections now before me, I have seen only two species from the Papuan subregion. This paper includes the descriptions of these two new species from the collection of the

Hawaiian Sugar Planters' Experiment Station which are from Larat Island (in the Tenimbar group between New Guinea and Timor), and it is written principally to record the new zoogeographical data. With the present knowledge of the widespread distribution of the genus, we can safely say that it probably includes a large number of species. Undoubtedly many species inhabit the New Hebrides, Solomons, Bismarck and Papuan islands, and the genus may extend farther westward. Moreover, a number of allied new genera are among materials collected by me, and others surely remain to be discovered, for there is probably a whole group of genera centered around *Amblycnemus*.

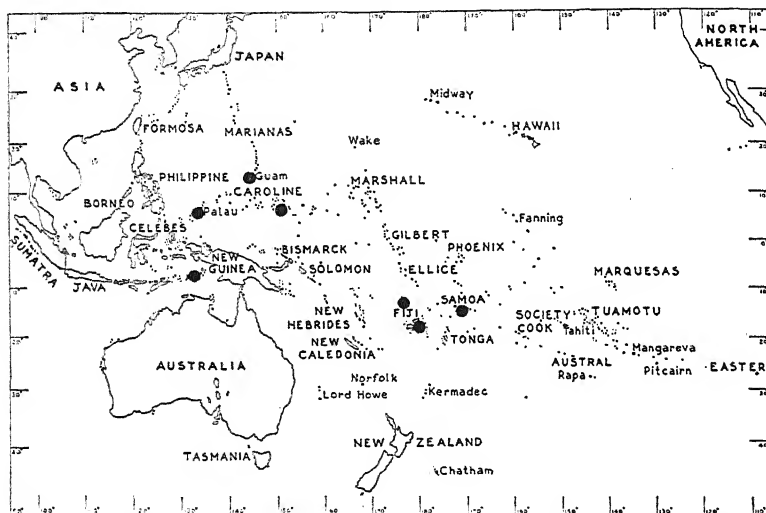


Fig. 1.—Map showing known distribution of the species of *Amblycnemus*.

The extraordinary resemblance in size, shape, color and color pattern of some of the species to members of the large cryptorhynchine genus *Trigonopterus* (*Idotasia*) is remarkable. And like members of that genus, the species of *Amblycnemus* which I have collected have rather similar habits as adults. That is, they may be most commonly found walking about on, or resting on, the leaves of various trees, shrubs and herbs in the forests. They seem to prefer large, shiny leaves. Nothing is known of their early stages.

The holotypes and allotype of the new species are stored in the type collection Bishop Museum, and paratypes are also in the collection of the Hawaiian Sugar Planters' Experiment Station.

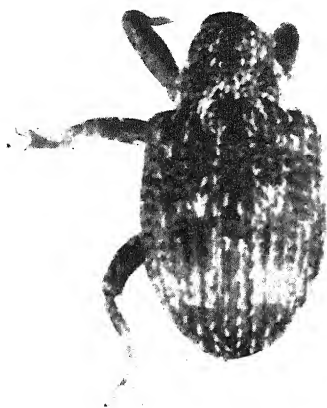


Fig. 2.

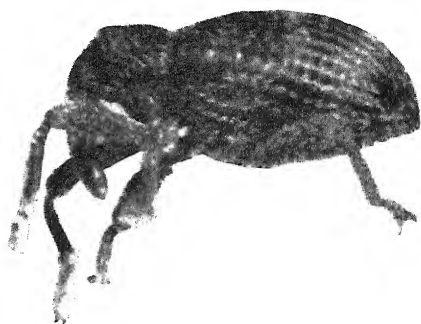


Fig. 3.

Figs. 2 and 3.—Dorsal and lateral views of holotype of *Amblycnemus fasciatus*, new species (photographs by W. Twigg-Smith, courtesy of Hawaiian Sugar Planters' Association).

The species of the genus thus far described are as follows:

1. *Amblycnemus stevensoni* Marshall, genotype.<sup>1</sup>  
Insects of Samoa, 4(5): 266, fig. 6, 1931.  
Tutuila and Upolu Islands, Samoa.
2. *Amblycnemus dentifer* Zimmerman.  
Proc. Haw. Ent. Soc., 11(1): 95, 1941.  
Melekeiok, Palao Islands, and Truk, Caroline Islands.
3. *Amblycnemus dentipes* Zimmerman.  
Bishop Mus. Bull. 172: 96, pl. 6, fig. F, 1942.  
Guam, Marianas Islands.
4. *Amblycnemus fulgidus* Zimmerman.  
Bishop Mus. Occasional Papers, 17(14): 185, fig. 1, *a, b*, 1943.  
Rotuma Island.
5. *Amblycnemus fasciatus* Zimmerman, new species.  
Larat, Tenimbar Islands.
6. *Amblycnemus laratensis* Zimmerman, new species.  
Larat, Tenimbar Islands.

***Amblycnemus fasciatus*, new species (figs. 2, 3).**

Male. *Color*: derm reddish brown to piceous; elytra with a broad, dark, or black fascia just before middle, a similar fascia just behind middle and entire apical fifth dark, these fasciae probably subject to some individual variation; setae white and conspicuous; entire derm moderately coarsely reticulate or alutaceous and comparatively dull over all.

<sup>1</sup> Note: in my paper, Curculionidae of Guam, Bishop Mus. Bull. 172: 95, 1942, there are three serious typographical errors in the references to this genus and species. For 1921, read 1931 in both places, and for p. 226, read p. 260.

*Head* with crown coarsely reticulate; punctures medium sized, rather obscured by the coarse reticulation and bearing anteriorly directed prostrate or nearly prostrate setae which are obviously smaller and less conspicuous than those on interocular area; longitudinal dorsal contour of head and rostrum continuous; eyes moderately convex, interrupting lateral contours of head; interocular area slightly narrower than base of rostrum, with conspicuous, suberect, curved, narrowly lanceolate, squamiform setae continued from rostrum to tops of eyes.

*Rostrum*, in male, with its lower chord about one fourth longer than pronotum, gently arcuate, gradually, slightly expanded from base to apex; antennae inserted at about one third distance from apex; with a single, fine median carina from just behind antennal insertion to base, lateral sulci and carinae obscure or wanting; with three rows of conspicuous, decurved, lanceolate squamiform setae on either side of median line behind antennal insertions.

*Antennae* (described from left antenna removed from holotype) with the slender but clavate scape about as long as remainder of antenna, clava about two fifths as long as entire scape, its broadest part about one fourth broader than funicular segment I; funiculus with segment I about twice as long as broad, almost as long as segments II plus III, segment II somewhat longer than III, III to VI successively shorter and broader; club approximately as long as first two funicular segments together.

*Prothorax* slightly transverse (21 units wide to 17 long in holotype), broadest at about basal third, subapical constriction broad and shallow, only shallowly interrupting the otherwise slightly arcuate dorsal contour at apical third; punctures moderately coarse, dense, interstices between them narrower than diameters of punctures; with conspicuous, decurved, squamiform setae similar to those on rostrum, most abundant on sides, at apex and on either side of median line.

*Scutellum* bare, rounded, convex.

*Elytra* about three fourths as broad as long, three times as long as prothorax, broadest at about middle, breadth across humeri about one and three quarters times as broad as prothorax; base sinuous; sides just perceptibly narrowed behind humeri, thence broadly arcuate to the broadly rounded apices, subapical constriction obsolete, longitudinal dorsal contour almost evenly arcuate throughout; striae deep and distinctly impressed throughout, stria ten not continued beyond hind coxae; stria punctures distinct and conspicuous, those toward base large, coarse, subquadrate, and as broad or broader than intervals, but becoming smaller caudad and those behind middle less distinct and narrower than intervals, some of the punctures bearing decumbent, squamiform setae similar to but smaller than those on intervals; intervals distinctly convex, bearing conspicuous, well separated, white, narrowly lanceolate, decurved, squamiform setae in single rows excepting for a few extra setae at base and about middle of interval three.

*Legs* with femora shallowly and indistinctly punctured, bearing conspicuous, white, narrow, decurved setae, hind pair not extending behind third ventrite and armed beneath with a conspicuous, acute tooth, middle pair with a minute denticle and fore pair unarmed in holotype; tibiae not carinate, bearing finer, less conspicuous setae than those on femora, evidently unarmed at apices; tarsi with some of the dorsal setae stouter than others and elongate-sub-squamiform, third segment deeply bilobed and as broad as length of II plus III.

*Sternum* with prosternal canal densely set with plumose setae, side walls in front of coxae low, almost straight, simple, only slightly and indistinctly elevated behind fore coxae; mesocoxae separated by about the breadth of a mesocoxa; metasternum with disk shiny, sides dull, shortest distance between mid and hind coxae about equal to length of a metacoxa, with large, con-

spicuous, setiferous punctures around edges, sides coarsely and deeply punctured, the punctures broader there than on disk; metepisternum with a single row of narrowly spatulate, squamiform setae and with a row of similar setae on mesepisternum.

*Abdomen* tumid, first ventrite broadly arcuate between coxae, impressed in middle in male, punctures coarsest and closest along fore margin, punctures bearing fine, decurved setae, length along median line about equal to length of ventrites II to IV inclusive; suture between I and II obliterated at middle; ventrite II with small, scattered, setiferous punctures; ventrites III to V inconspicuously punctate and setose; ventrite V almost as long as III plus IV.

Length (excluding head and rostrum): 1.75 mm.; breadth: 0.9 mm.

Larat Island. Holotype male collected in December 1907 by F. Muir.

This species belongs to the *dentifer-dentipes* group of the genus, and it is closely similar to each of those species. It most closely resembles *A. dentipes* from Guam, but that species and *A. dentifer* each have all the femora dentate and on each of those species the hind femora are longer than on *A. fasciatus*. There are other characters, such as the proportions of various structures and parts of the body, that will also serve to distinguish these three species.

*A. dentifer*, *A. dentipes* and *A. fasciatus* form a group of species which is most distinct from *A. fulgidus* and *A. laratensis*, with the genotype, *A. stevensoni*, in between. In fact, before they are critically examined, such species as this new one and *A. fulgidus* hardly appear to belong to the same genus.

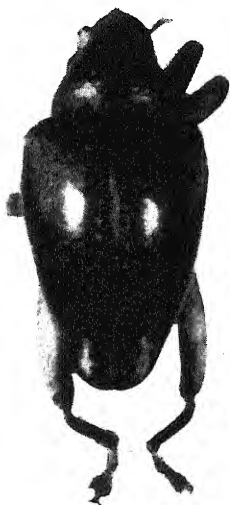


Fig. 4.

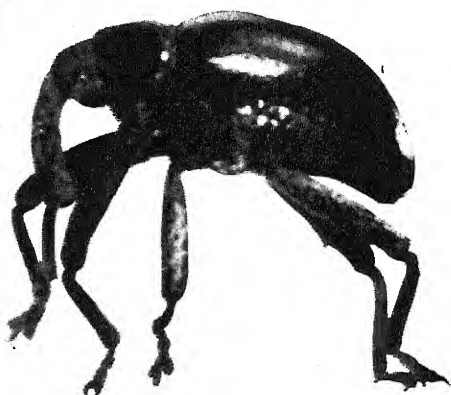


Fig. 5.

Figs. 4 and 5.—Dorsal and lateral views of *Amblycnemus laratensis*, new species (photographs by W. Twigg-Smith, courtesy of Hawaiian Sugar Planters' Association).



**Amblycnemus laratensis**, new species (figs. 4, 5).

*Color:* derm piceous to black, moderately shiny above; squamae white; elytra each with a subapical vitta of white scales, dorsum otherwise without markings.

*Head* densely punctate, but with the coarse reticulation sometimes obscuring the individual punctures; each puncture on crown containing a narrow, anteriorly directed, prostrate or subprostrate squamiform seta, with two rows of more conspicuous scales on sides behind each eye; interocular area not more than one half as broad as base of rostrum, with a narrow median carina and a row of subprostrate or reclinate, lanceolate or subspatulate setae in the sulcus on each side of the median carina; longitudinal, median dorsal contour of front continuous with that of rostrum; eyes only slightly convex, not protuberant.

*Rostrum* in male with its lower chord about 1.3 times as long as pronotum, compressed at base and there about 0.8 as broad as depressed apex or about 0.8 as broad as height of base, gently arcuate, antennae inserted between distal one fourth and one third, carinae and intervening sulci conspicuous, with three dorsal and two lateral carinae (the outer lateral carinae at the dorsal scrobal margin) and with a short, somewhat obscure subbasal lateral carina between the outer dorsal and inner lateral carinae; sulci between carinae with conspicuous, mesially or mesad-cephalad directed lanceolate or narrowly subspatulate squamae; essentially similar in female, but more slender and with carinae and sulci less strongly developed, the median carina absent and setae fine instead of squamiform.

*Antennae* with the slender scape not quite as long as funiculus plus first segment of club, feebly clavate, hardly broader at its broadest part than first funicular segment; funicular segment I subequal to II, fully twice as long as broad, about twice as broad as apex of II, II slightly longer than III plus IV, III conspicuously longer than IV, IV to VI successively slightly broader, VI about as broad as long; club slightly longer than funicular segments III to VI inclusive, about one half as broad as long.

*Prothorax* distinctly transverse (about 40:27), broadest within basal third, arcuately narrowing from base to the narrow subapical constriction which is very near apex; subapical constriction not or indistinctly interrupting the otherwise evenly convex longitudinal dorsal contour; base strongly sinuous; distance across dorsum at subapical constriction approximately equal to length of pronotum; punctures medium sized, separated by interstices broader than their diameters toward base of disk, but distinctly denser and with narrower interstices cephalad, each puncture bearing a fine, inconspicuous, prostrate seta.

*Scutellum* bare, disk usually depressed.

*Elytra* about three fourths as broad as long, about three and one half times as long as prothorax, broadest behind humeri; base sinuous; humeri broadly angulate; sides sub-triangularly narrowed from just behind humeri to the broadly rounded apices; subapical constriction feeble; longitudinal dorsal contour rather strongly and evenly arcuate from base to apex, rising distinctly above level of pronotum, its highest point at about middle; intervals broad and flat, much broader than stria punctures on disk, with indistinct, microscopical setae only, but with a conspicuous vitta of broad, white, spatulate squamae, on apical part of interval three which begins at a point about opposite the apices of striae three and four; striae not impressed except near sides and at apex, but with regular rows of medium sized, distinct, well separated punctures, ninth stria merging with tenth above first ventrite.

*Legs* with femora densely and coarsely punctate, each puncture bearing a conspicuous seta, those on the dorsal edges of mid and hind pair (rarely on fore pair), and especially on hind pair, mostly squamiform, subspatulate and conspicuous, thus the hind pair at least with a white dorsal vitta; hind femora reaching about to apex of elytra, with a well developed, narrow, sharp tooth beneath, middle pair with a smaller tooth and fore pair with or without a small tooth (obscure or absent in female); tibiae distinctly multi-carinate, with fine, curved, subprostrate setae in the sulci, mid and hind pair of male mucronate (but with the mucrones usually obscured by the terminal setae), female without tibial mucrones; tarsi with third segment deeply bilobed, about twice as broad as long, slightly broader than length of II plus III.

*Sternum* with prosternal canal with only a few setae, side walls in front of coxae distinctly notched so as to form two tooth-like tubercles when viewed from side, but these usually somewhat obscured by setae and an exudate in the fovea on side of prothorax at base of the side walls; side walls not distinctly elevated behind coxae; mesocoxae about as widely separated as breadth of a mesocoxa; metasternum with ventral part shiny, punctate around edges and with fine setae in the punctures, outer vertical parts below pleura with large, white squamae borne from the coarse punctures, a deep, longitudinal, fovea-form, apical depression on median line, distance between mid and hind coxae approximately equal to length of a metacoxa; pleura without distinct setae or squamae, metepisternum with a single row of punctures.

*Abdomen* with first ventrite broadly concave, more deeply so in male than female, disk with distinct, but comparatively shallow punctures bearing decurved setae, length along median line equal to length of II to IV inclusive, suture between I and II obliterated in middle; ventrite II with rather obscure punctures bearing fine setae; ventrites III and IV coarsely reticulate and without conspicuous punctures or setae; ventrite V densely set with setiferous punctures, coarsely reticulate and with a conspicuous, deep, subapical median fovea.

Length (excluding head and rostrum): 2.5-2.9 mm.; breadth: 1.3-1.5 mm.

Larat Island. Holotype male, allotype female, five female paratypes, 16 male paratypes, four teneral males and two teneral females collected in December 1907 by F. Muir.

This species more closely resembles *A. fulgidus* than any of the other described species. It is, however, quite distinct from that species. The fovea on the fifth ventrite is peculiar.

## New Insect Records for the Year 1943

BY THE EDITOR

The following list of insects recorded for the first time in Hawaii during the past year, is a continuation of a record begun in the Proceedings by Mr. O. H. Swezey with a list of the immigrants for 1919 (Proc. Haw. Ent. Soc., 4 [2] : 448, 1920). Species marked with an asterisk were observed for the first time in 1943, on the date mentioned in the text. The others were observed here prior to that year, but have only now been identified. For details of the records refer to the pages indicated.

## Chance Immigrants

<i>Eriophyes litchii</i> Keifer (Acarina).....	6 (footnote)
* <i>Hercotrips fasciatus</i> (Pergande) (Thysanoptera).....	14
* <i>Aphis ferruginea-striata</i> Essig (Homoptera-Aphididae).....	17
* <i>Aphis tavaresi</i> Del Guercio (Homoptera-Aphididae).....	17
<i>Neophyllaphis araucariae</i> Takahashi (Homoptera-Aphididae).....	17
<i>Acrolepia assectella</i> (Zeller) (Lepidoptera).....	19, 22
* <i>Hormius pallidipes</i> Ashmead (Hymenoptera).....	17, 22
* <i>Apanteles dignus</i> Muesebeck (Hymenoptera).....	17, 22, 91
<i>Cardiocondyla emeryi</i> Forel (Hymenoptera).....	25
* <i>Latrodectus mactans</i> var. <i>hesperus</i> Chamberlin & Ivie (Arachnida)....	26
<i>Podagrion mantis</i> Ashmead (Hymenoptera).....	92
<i>Amphorophora sonchi</i> (Oestlund) (Homoptera-Aphididae). Previously recorded in Hawaiian Agr. Expt. Sta. Rept. (1940) : 44, 1941, but not noted before in these Proceedings.....	95
<i>Aphis rumicis</i> Linn. (Homoptera-Aphididae).....	95
<i>Brachycolus heraclei</i> Takahashi (Homoptera-Aphididae).....	96
<i>Macrosiphum rosaefolium</i> Theobald (Homoptera-Aphididae).....	97
<i>Myzus convolvuli</i> (Kaltenbach) (Homoptera-Aphididae).....	97
<i>Spaniotoma</i> ( <i>Smittia</i> ) <i>maculiventris</i> Edwards (Diptera).....	164
<i>Ornithodoros megnini</i> (Dugés) (Ixoidea).....	199
<i>Liponyssus bursa</i> (Berlese) (Acarina).....	200
* <i>Polyplax spinulosus</i> (Burmeister) (Anoplura).....	200
* <i>Linognathus africanus</i> Kellogg & Paine (Anoplura).....	200
* <i>Gliricola porcelli</i> (Linn.) (Anoplura).....	200
* <i>Bovicola bovis</i> (Linn.) (Anoplura).....	200
<i>Bovicola caprae</i> (Gurlt) (Anoplura).....	200
<i>Felicola subrostrata</i> (Nitzsch) (Anoplura).....	200
* <i>Columbicola columbae</i> (Linn.) (Anoplura).....	200

## Beneficial Insects Purposely Introduced

* <i>Apanteles marginiventris</i> Cresson (Hymenoptera).....	3
* <i>Anagrus yawi</i> Fullaway (Hymenoptera).....	15, 57

PROCEEDINGS  
OF THE  
Hawaiian Entomological Society

Editor Emeritus, O. H. Swezey

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VOL. XII, No. 2

FOR THE YEAR 1944

JUNE, 1945

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JANUARY 10, 1944

The 457th meeting was held at the H.S.P.A. Experiment Station on Monday, January 10, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Carter, Craft, Faxon, Fullaway, Holdaway, Keck, Look, McBride, McPhail, Murakami, Nishida, Pemberton, Rosa, Sakimura, Schmidt, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Thomas Farr, Ensign H. E. Graham and Capt. Franklin Sherman III.

Mr. Wm. Craft was unanimously elected to membership.

NOTES AND EXHIBITIONS

*Eucnocerus anthrenoides* Sharp—Mr. Pemberton exhibited dry lettuce seed removed from a sealed paper package; these were being consumed by this dermestid beetle, all stages being present. The larvae appeared well-fed and had matured to large-sized individuals.

*Fly control in carrion*—Mr. Pemberton discussed the use of undiluted cresylic acid on dead animals and other carrion for the elimination of flies and their maggots from such materials. He said that Dr. F. E. Hance, chemist of the H.S.P.A. Experiment Station, had sprayed cresylic acid over a dead squid which was covered with flies, mostly *Lucilia* sp., and filled with their maggots, with the result that the flies completely disappeared within a few minutes, and all the maggots died within 24 hours. Following treatment, the carcass was left in the field and kept under observation. At no time did the flies return; after ten days the squid dried up. A pronounced odor of cresylic acid permeated the air for at least 20 feet from the treated spot throughout the period of the observations.

Dr. Carter said he had found that crude naphthalene sprinkled on decaying animal parts (e.g., chicken head) entirely and very quickly eliminated the odor of decay, and prevented the breeding of

maggots in the material. Capt. Sherman remarked that paradichlorobenzene (PDB) was very successful in eliminating flies from latrines.

*Tenodera angustipennis* Saussure—Mr. Swezey exhibited an egg case of this mantid brought in by Dr. H. L. Lyon, who found it in his garage on Matlock Avenue. This egg case displayed 45 round exit holes in the sides, from which parasites had already issued. Presumably the parasite would be the same one found by Mr. Krauss last year on Molokai, provisionally determined by Mr. Fullaway as *Podagrion beneficium* Girault.<sup>1</sup> This is evidence of the establishment of this parasite on Oahu, where it is evidently a factor in causing the scarcity of the mantis of late years.

*Lindera tessellatella* Blanchard—Mr. Swezey exhibited a specimen of this tineid moth collected by him at Kula, Maui, January 26, 1911. It was at a time when Mr. Swezey was investigating the occurrence in stored corn of *Sitotroga cerealella* (Oliv.) in that region. Three of the *Lindera* moths were collected, probably in corn, though not so labelled and he could not be certain from memory. The specimens had remained undetermined until Mr. Swezey noticed a recent account of this moth in England (The Entomologist, 76:177-181, 12 figs., 1943) with description and figures from which the determination was made. The caterpillars are said to be refuse feeders. The species is recorded from South America, Australia, New Zealand and Fiji. It was described from California (Trans. Amer. Ent. Soc., 31:13, 1905) by Dietz as *Paraneura simulella*, which later proved to be a synonym. No other specimens have been obtained in Hawaii. The moth has considerable resemblance to *Sitomorpha insectella* (Fabr.), another scavenger moth in Hawaii, but the wing venation is different.

*Herse cingulata* (Fabr.)—Dr. Williams reported rearing a male of this sweetpotato sphinx moth from a small caterpillar feeding on a sunflower plant (*Helianthus annuus* Linn.) in his garden in Honolulu. The sunflower was growing alongside sweetpotatoes. Two sphinx moth eggs on the sunflower leaves yielded *Trichogramma* wasps. The caterpillar was fed entirely upon sunflower leaves and produced the moth on December 19.

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## FEBRUARY 14, 1944

The 458th meeting was held at the H.S.P.A. Experiment Station on Monday, February 14, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Carter, Craft, Faxon, Fullaway, Goolsby, Holdaway, Krauss, Look, McBride, Murakami,

<sup>1</sup>Later identified by A. B. Gahan as *Podagrion mantis* Ashmead. See Proc. Haw. Ent. Soc. 12: 82, 92, 1944 [Ed.].

Nishida, Pemberton, Rosa, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

Visitor: Mr. Foo Kau Lee.

On the occasion of Mr. Swezey's retirement from the editorship of the Proceedings, after 37 years tenure, Dr. Williams, on behalf of the Society, presented Mr. Swezey with a *Cypripedium* orchid in flower, as a token of the Society's appreciation. In the same connection the following resolution was unanimously adopted:

WHEREAS: Mr. O. H. Swezey has, at his own request, given up the editorship of the Society's Proceedings after thirty-seven years of service, in order to devote himself further to his studies of the Hawaiian insect fauna, and

WHEREAS: Mr. Swezey has, during this time edited the first eleven volumes of the Proceedings, consisting of thirty-nine separate issues containing over 5000 pages of text, these constituting an enduring and unique monument to his wholehearted devotion to science, and to Hawaiian entomology in particular, therefore

BE IT RESOLVED: That this Society express to Mr. Swezey its appreciation of a task well done, and thank him for his long and faithful service.

#### NOTES AND EXHIBITIONS

*Eucelatoria armigera* (Coquillett)—Mr. Van Zwaluwenburg recorded the first rearing in Hawaii of this tachinid fly from *Heliothis armigera* (Hübner), the host from which the type material in California had been reared. A *Heliothis* larva taken on potato foliage in Field 13, Oahu Sugar Company, Ltd., on January 20, yielded three puparia, from which issued, on January 30 and 31, three females of *Eucelatoria*. Adults of this fly were present in large numbers in Field 13 on February 9; some five weeks later the species was no longer to be found, indicating a seasonal fluctuation.

*Dysimnia maculata* Muir—Mr. Van Zwaluwenburg noted that the type locality of this derbid, omitted from the original description (Proc. Haw. Ent. Soc., 5: 463, 1924), is (according to labels on the type in the H.S.P.A. Experiment Station collection) Rio Piedras, Puerto Rico, where it was taken, feeding on *Inga* sp., in August 1923, by G. N. Wolcott.

*Agromyza virens* Loew reared from celery—Dr. Holdaway exhibited specimens of this fly reared from a stalk of celery grown at Kurtistown, Hawaii, July 23, 1941. The celery in which the larvae were working exhibited a brownish, corky condition in the groove of the stalk, somewhat like the condition now known to be due to a boron deficiency, and observed elsewhere on Hawaii and Maui. This condition gives the stalk a brown line from near the ground level to near the lamina of the leaf. If the condition of the celery stalk from which *A. virens* was reared, actually was due to boron deficiency, one is led to wonder if the agromyzid was merely

secondary. Identification of the fly was made by Mr. Swezey who referred to remarks by Essig (Insects of Western North America: 614, 1926) to the effect that "*Agromyza virens* Loew mines the stems of white clover, ragweed, and coneflower, and occurs in the east and in Arizona and California in the west."

*Podagrion* on Oahu—Mr. Swezey exhibited specimens of this egg parasite on mantid eggs, which had issued from oothecae of *Tenodera angustipennis* Sauss., collected by Mr. Bianchi and himself February 4, 1944, at the H.S.P.A. substation in upper Manoa Valley. Eight oothecae were collected from twigs of hibiscus and on the boards of a shed. Six of the egg cases had exit holes where the parasites had already issued. From the fresher-looking oothecae, 14 female *Podagrion* issued between February 3 and 13. During the same time, six females and three males of *Cerambycobius cushmani* Crawford issued from these oothecae. No male *Podagrion* issued, and this seems to indicate that the species is parthenogenetic. On February 12 four females were placed with what appeared to be an unparasitized ootheca, and on February 14 they were all observed ovipositing.

*Mantids from Kauai*—Dr. Krauss exhibited three species of mantid established on the island of Kauai: (1) *Tenodera angustipennis* Sauss.; one adult, Waimea, January 6, 1944; one nymph, Haena, January 7; one nymph, Waipahee, January 13; two egg cases from branches of *Acacia farnesiana* (Linn.) Willd. Showing numerous exit-holes of a parasite, probably *Podagrion mantis* Ashm., Polihale, January 12; one egg case, Nawiliwili, October 20, 1942. (2) *Hierodula patellifera* (Serv.); one adult female and three nymphs, Waimea, January 6, 1944; two adult males, Hanapepe valley, January 14. The males, which apparently have not been previously collected in the Islands, are dark brown in color, in contrast to the green female. (3) *Orthodera ministralis* (Fabr.); one female collected by Otto Degener near Hanalei, December 1939, and an egg case laid by this individual.

*Dendrothripoides ipomeae* Bagnall—Messrs. Look and Nishida exhibited photographs and specimens of sweetpotato showing injury by this thrips. This species was first collected on *Echinochloa crus-galli* Beauv., by Mr. Bianchi in March 1940 (Proc. Haw. Ent. Soc. 11 [1]: 38, 1941); in 1941 it was found on sweetpotato (ibid: 11 [2]: 138, 1942). Bianchi reported no visible damage to sweetpotato by populations of moderate density, and suggested that "there is even some indication" that the species may be predaceous on the eggs of *Bedellia orchilella* Walsm., the tineid leaf miner of sweetpotato. However, recent observations show that this thrips is capable of considerable injury to sweetpotato under some conditions. The injured leaves are scarred and crinkled by the thrips which breed in the young shoots. This injury is easily confused with that of the broad mite, *Hemitarsonemus latus* (Banks).

Severe injury to sweetpotato was first noted in May 1942 at the University farm. Observations during 1943 also showed the presence of this thrips, with attendant malformations and severe injury, on sweetpotato at Kalihi, Oahu. Slight damage was noted in a large planting at Lihue, Kauai in August 1943. In May 1942, when injury to sweetpotato was first observed, moderate damage to lettuce growing nearby was also noted. Previous mention of this species on sweetpotato and lettuce was made by Sakimura and Nishida (Proc. Haw. Ent. Soc., 12: 125, 1944).

*Meteorus laphygmae* Viereck—Mr. Pemberton reported that an adult of this introduced braconid parasite of the nutgrass armyworm, was reared from a larva of *Laphygma exigua* (Hübner) collected on potato leaf in Field 13, Oahu Sugar Co., Ltd. on January 20, 1944. This is the first indication of the establishment on Oahu of this species which was introduced from Texas in 1942. On January 26, larvae of *Heliothis armigera* (Hübner) were obtained in the same field, parasitized by the same braconid.

*Conocephalus saltator* (Sauss.)—Mr. Pemberton stated that he had observed this locustid eating the soft kernels of unripe corn ears at the outer ends where the husks had been torn back by observers to study the developing seeds within.

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### MARCH 13, 1944

The 459th meeting was held at the H.S.P.A. Experiment Station on Monday, March 13, at 2:00 p.m. with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Faxon, Fullaway, Holdaway, Krauss, Look, McPhail, Marlowe, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

### NOTES AND EXHIBITIONS

*Podagrion* sp.—Mr. Swezey exhibited numerous males of this callimomid parasite of mantid eggs. They were the progeny of unmated females confined with a mantid egg mass on February 14. Oviposition was observed for three or four days. These males began issuing on March 9, and by March 13, 125 had issued. The life cycle is very short: 24 to 28 days.

*Graptostethus nigriceps* Stål<sup>2</sup>—Mr. Swezey exhibited an adult of this lygaeid bug which had just matured from a nymph found March 7 on *Ipomoea tuberosa* Linn. He also reported small nymphs present on the same vine, hiding in old capsules which were more or less split. No feeding has yet been observed.

<sup>2</sup>Mr. Swezey has since determined that the *Graptostethus* in Hawaii is not *nigriceps*, but *G. servus* (Fabr.); see his article, p. 335 [Ed.].



*Lasioderma serricorne* (Fabr.)—Mr. Krauss reported finding many cigarette beetles on February 17 infesting dried skim milk in barrels, which had been stored for many months in a Honolulu warehouse.

*Nymphula oblitalis* (Walker)—Mr. Krauss reported that a single specimen of this pyralid moth, the larvae of which feed on water lily plants (*Nymphaea*), was collected on the side of a lily pond at Lihue, Kauai, January 10, 1944. This is the first record of the species from Kauai.

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#### APRIL 10, 1944

The 460th meeting was held at the H.S.P.A. Experiment Station on Monday, April 10, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Faxon, Fullaway, Holdaway, Hyslop, Krauss, Look, Murakami, Nishida, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Messrs. Robert Englehard and Joji Iwamoto.

The Secretary announced that on March 23rd the executive committee had appointed Mr. O. H. Swezey editor emeritus of the Society's Proceedings.

#### NOTES AND EXHIBITIONS

*Apterocyclus waterhousei* Sharp—Mr. Van Zwaluwenburg presented the following note: The six species of the lucanid genus *Apterocyclus* Waterhouse from the island of Kauai, described by Sharp in 1908 (Fauna Haw., 3 [5]: 403-405, pl. 13, figs. 1-5) were, later, all reduced to synonymy under *A. honoluluensis* Waterhouse by Van Dyke (Proc. Haw. Ent. Soc., 5: 39-49, pl. 1, 11 figs., 1922), who considered *waterhousei* to be a phase or variety of *honoluluensis*. Recently Arrow (Proc. Roy. Ent. Soc. London, (B) 12: 138, October 29, 1943), after agreeing that five of Sharp's six species belong to the variable *honoluluensis*, writes as follows: "The type of *A. waterhousei* Sharp, however, differs so greatly from the other six types in the British Museum, that I am unable to adopt his [Van Dyke's] view that this species is not separable from *A. honoluluensis* Wat. The very much stouter legs, the straight sides of the pronotum and its abrupt hind angles, the flattened sides of the elytra and sharply angular apices separate it widely from all the other specimens known to me. The stout legs suggest the female sex, but the specimen is a male, and the sexes of *Apterocyclus* do not vary in this way. It seems likely that, as in other wingless genera (e.g. *Colophon*), it may be found that there are several geographically isolated species of very narrow range in the genus."

*First record of a cercopid in Hawaii*—Mr. Faxon reported for Warren Goolsby that *Philaenus leucophthalmus* (Linn.), the first cercopid known in the Hawaiian Islands, was collected by him at an elevation of 3400 feet, near the Volcano House on Hawaii, on January 17, 1944. Adults were found on daikon (*Raphanus sativus* Linn. *longipinnatus* Bailey) and on satsuma orange leaves. The identification of the insect was made by Dr. R. I. Sailer.

*New generic name for sugar cane beetle borer*—Mr. Zimmerman reported that Sir Guy Marshall (Ann. Mag. Nat. Hist. [11] 10: 119, 1943) has proposed the new name *Rhabdoscelus* for *Rhabdonemis* Faust 1894, which is preoccupied by Pomel's 1872 genus of sponges. The name of the New Guinea sugar cane weevil therefore becomes *Rhabdoscelus obscurus* (Boisd.).

MAY 8, 1944

The 461st meeting was held at the H.S.P.A. Experiment Station on Monday, May 8, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Faxon, Fullaway, Goolsby, Holdaway, Hyslop, Keck, Krauss, Look, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Lt. Arthur C. Smith; Messrs. D. D. Jensen and Richard Kung.

#### PAPER

In behalf of Dr. R. L. Usinger, Mr. Swezey presented a paper entitled: "Distribution of *Icteronysius*, with Description of a new Subspecies from Haleakala (Hemiptera, Lygaeidae)."

#### NOTES AND EXHIBITIONS

*Scale insect new to Hawaii*—Mr. Fullaway exhibited a species of scale insect of the genus *Lepidosaphes*, that appears new to the Territory. It was found recently in large numbers on flower stems of orchids, and evidently came from the Orient.

*Collembola feeding on "white rust" and on Chinese cabbage*—Dr. Holdaway presented the following note for Mr. Tanada: On April 14, while collecting in the elementary school garden of the University of Hawaii, a student (Yoshinori Tanaka) called my attention to minute insects congregated near the pustules of "white rust" (*Albugo candida* [Pers.] Gray) on the under surface of leaves of Chinese cabbage (*Brassica pekinensis* Rupr.). The insects also were abundant in the soil at the base of the plants, which were from 4 to 6 inches tall. The insects were collembolans belonging to the family Sminthuridae. Under the dissecting microscope it was

observed that the fungus pustules had been consumed by the Colembola. The following day, when additional material was collected, some of the insects were found feeding on the young, fully expanded leaves and on the older leaves lying close to the soil. Their feeding resulted in small cavities scooped out of the lower surface of the leaf, but not penetrating through the upper epidermis. In one or two cases the insects were feeding on the upper surface of the leaf. The feeding cavities, as the leaf grows older, develop into tiny holes. Although "white rust" is spread by wind, the feeding of this insect on both the fungus and the cabbage plant may be another means of spreading the fungus.

*Philaenus spumarius* (Linn.)<sup>3</sup>—Mr. Krauss reported as follows on this, the "meadow froghopper": He observed this cercopid to be numerous in the Kilauea area on the island of Hawaii during April 1944. Nymphs in typical masses of froth were collected from the following plants: celery, parsley, mint (*Mentha* sp.), poha (*Physalis peruviana* Linn.), strawberry, blackberry (*Rubus penetrans* Bailey), Shasta daisy (*Chrysanthemum maximum* Ram.), (*Mesembryanthemum* sp.), fuchsia, evening primrose (*Oenothera odorata* Jacq.), *Coprosma rhynchocharpa* Gray and *Geranium carolinianum* Linn. var. *australe* (Benth.) Fosb. The insects were found in the truck garden area below the Hilo entrance to the National Park, and in various places within the park, including the Bird Park. None was seen at other places on the island. A Japanese truck farmer at Kilauea said that he had first observed this insect about two or three years ago. The nymphs are light greenish in color, and very soft-bodied. No adults were seen in the masses of froth.

*Eucelatoria armigera* (Coq.)—Mr. Pemberton reported that this immigrant tachinid fly is now known to be established on the islands of Kauai, Oahu, Maui and Hawaii. Its presence on Kauai and Hawaii has only recently been determined. Mr. Krauss collected it on Kauai in January 1944, and the identification was made by Dr. Williams three months later. The Hawaii material was collected by Lt. George Greenberg, U.S.N.R. at Kamuela, and submitted for identification on May 2, 1944. Of interest was the rearing of two of these flies by Mr. Rosa from a well-grown larva of *Cirphis unipuncta* (Haw.), which was collected on grass at Waikiki in April. The larva was also parasitized by *Euplectrus platyhyphenae* Ashm., but the eulophid parasite failed to develop because of the rapid maturity of the tachinid larvae.

*Mango blossom spike as fly trap*—Mr. Pemberton exhibited some undeveloped flower spikes taken from a mango tree near Lihue, Kauai to which were attached many dead *Musca domestica* Linn. This material was collected by Dr. A. J. Mangelsdorf who observed

<sup>3</sup>This is the same insect referred to on page 219 as *P. leucophthalmus* (Linn.). Stearns (Hemiptera of Connecticut: 225, 1923) considers *leucophthalmus* to be a variety of *spumarius* but apparently there continues to be divergence of opinion on the matter among students of the group. [Ed.].

quantities of this fly attached to similar flower spikes on the same tree.

*Liponyssus bursa* (Berlese)—Mr. Pemberton discussed the annual relation between nest building by the mynah bird, and complaints by local residents of both mild and acute dermatitis caused by this bird mite. Nest building is extensively under way at the present time, and mites are already appearing in houses where nests have been built in the eaves and accessible attics, or in shrubbery close to windows and doors. Where this form of dermatitis is reported, heavily infested nests are invariably found nearby. Removal of the nests results in disappearance of the mites.

*Micromyzus formosanus* (Takahashi)—Mr. Pemberton exhibited the tops of some California dried onions which had sprouted in a screened cooler in his house after having been held in the cooler for a month. The green sprouts had developed a large colony of this onion aphid. In his opinion, this demonstrates how the aphid could have been introduced into Hawaii from California. When the onions were purchased they had no sprouts, but undoubtedly carried some of the aphid concealed beneath the loose scales at the apex of the affected bulbs.

*Ischnaspis longirostris* (Sign.)—Mr. Swezey exhibited leaves of *Ficus benghalensis* Linn. which were profusely covered with the black thread scale. Many leaves had fallen from the large banyan tree near the Mormon church on Beretania street, and most of them were heavily infested with this scale. Mr. Swezey estimated the number of scales on one leaf by counting those on a square inch, which came to 260 (about as many on one side of the leaf as on the other), totalling 4100 for the whole leaf of 16 square inch expanse. Considering the immense size of the tree with its many thousands of leaves, the scale population of the entire tree would be tremendous. However, the tree was not badly affected by the heavy infestation, but had a very thrifty appearance. "*Thoracaphis ficus* Baker",<sup>4</sup> the peculiar aphid which simulates an aleurodid in appearance, was present on some of the leaves.

*Ischnura posita* (Hagen)—Dr. Williams spoke of rearing this little immigrant damselfly. Nymphs hatched from eggs laid in *Pistia* plants. A nymph about 4.5 mm. long, exclusive of the gills, had stationed itself on the side of a glass dish close to the surface of the water. Tiny ostracod Crustacea of a spotted pattern were abundant and frequently swam under the very nose of *Ischnura*, which was perhaps eight times the length of these oval, clam-like organisms. It would readily capture an ostracod in its mask jaws, but cracking it was another matter. A seized crustacean would immediately draw its appendages within the shell, which, even in one-third grown specimens withstood the pressure of the jaws.

<sup>4</sup>Not the *T. ficus* (or *T. fici*) of authors, but a new species being described by Dr. E. O. Essig. [Ed.].

After more or less of a trial—very brief in the case of the large ostracods—the *Ischnura* would drop its captive which eventually swam off. Thus, in this sea of plenty, the younger nymphs were forced to subsist on even smaller organisms that were far from being a mouthful.

*Chelonus blackburni* Cam.—Dr. Williams told of watching this braconid wasp evidently ovipositing in the eggs of one of the aphidivorous syrphid flies found on the leaves of corn at the H.S.P.A. Experiment Station. This *Chelonus* is a parasite of some of our lepidopterous larvae.

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## JUNE 12, 1944

The 462nd meeting was held at the H.S.P.A. Experiment Station on Monday, June 12, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Carter, Craft, Faxon, Fullaway, Holdaway, Keck, Krauss, Look, McBride, Murakami, Nishida, Pemberton, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Capt. David G. Hall; Messrs. D. D. Jensen, Richard Kong and Lt. A. C. Smith.

Dr. Holdaway nominated Dr. D. D. Jensen for membership in the Society.

## PAPER

In behalf of Dr. C. P. Alexander, Dr. Williams presented a paper entitled: "New or Little Known Tipulidae from New Caledonia (Diptera)".

## NOTES AND EXHIBITIONS

*Gryptostethus servus* (Fabr.)—Mr. Fullaway exhibited a specimen of this lygaeid bug taken by Stephen Au on Kauai in May 1944, on flowering heliotrope. This is the first record of this insect on Kauai.

*Hercinothrips femoralis* (Reuter)—Mr. Fullaway exhibited specimens of this thrips from a banana plantation at Mokuleia, Oahu. The thrips were living on the banana fruits and doing serious damage. In the same neighborhood *Nysius* bugs were present in countless thousands, moving from *Amaranth* and pigweed to new growth on mango trees. The withdrawal of sap from these tender shoots actually destroyed the shoots.

*Mosillus* sp.—Mr. Krauss reported collecting three specimens of this ephydrid genus at Hanamaulu, Kauai, January 11, 1944. This is a genus new to the Hawaiian Islands. The specimens were determined by Dr. Williams.

*Solenopsis geminata rufa* (Jerdon)—Mr. Krauss presented the following: Many specimens of the fire ant were collected on a guava plant in the outskirts of Hilo, Hawaii on April 12, 1944; others were seen near the center of town. Previously this ant has been known only from Oahu, where it is widespread, from Rabbit island (off the northeastern coast of Oahu) and from Mahukona, Hawaii, where specimens were collected on May 13, 1931 by Dr. Swezey.

*Trichoplusia ni* var. *brassicae* (Riley)—Dr. Swezey noted that Dr. J. McDunnough has erected the genus *Trichoplusia* to contain the cabbage *Plusia*, under the combination given above. This moth was described as *Plusia brassicae* by Riley, and for a long time has been known as *Autographa brassicae*. The new genus *Trichoplusia* and the new combination are to be found in McDunnough's "Revision of the North American Genera and Species of the Phalaenid Subfamily Plusiinae" (Mem. South. Calif. Acad. Sci., 2 [2]: 204, 1944). There are four other new genera in the paper: *Anagrapha*, *Autoplusia*, *Pseudoplusia* and *Adeva*. Genital characters are used to distinguish the genera.

*Orchidophilus peregrinator* Buchanan—Dr. Carter stated that a three per cent dust of the new insecticide, DDT, applied to the orchid *Vanda teres* Lindley, proved fatal to this weevil within 48 hours.

*Apanteles marginiventris* (Cresson) and *Meteorus laphygmae* Viereck—Mr. Pemberton stated that during May 1944, evidence was obtained of the establishment on the island of Hawaii of these two parasites of several destructive lepidopterous larvae. He also mentioned the rearing of *A. marginiventris* from the larva of *Hymenia recurvalis* (Fabr.) from Hanalei, Kauai, where, during May of this year, Stephen Au collected amaranth leaves infested by *Hymenia*. Many cocoons of this *Apanteles* were found attached to the leaves, and Dr. Swezey noticed the typical remains of the head capsule of a *Hymenia* larva attached to one of the cocoons. No other lepidopterous larvae were seen on the amaranth leaves.

*Identity of the mongoose in Hawaii*—Mr. Pemberton reported that a member of the Marine forces on the island of Hawaii sent carefully prepared specimens of mongooses collected on that island, to Dr. Arthur Remington Kellogg, curator, division of mammals, United States National Museum, who identified them as *Herpestes javanicus auropunctatus* (Hodgson). He also referred to an extensive paper by R. I. Pocock, British Museum of Natural History, entitled "The Mongooses of British India, including Ceylon and Burma" (Jl. Bombay Nat. Hist. Soc., 39: 241, April 1937) in which this species is discussed at length. Pocock states that it is the same species introduced from British India and established in Jamaica and other West Indian islands. Since the mongoose in Hawaii was originally introduced from Jamaica in 1883, we have

here further evidence that the species present in Hawaii is the one named above.

*Eriococcus coccineus* Cockerell—Mr. Pemberton exhibited a small ornamental cactus plant infested with this coccid. It was found in a private cactus garden at Koloa, Kauai, on May 24, 1944, and was present on several species of cacti in the garden. This is a new record for the Territory.

### JULY 10, 1944

The 463rd meeting was held at the H.S.P.A. Experiment Station on July 10, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Carter, Faxon, Fullaway, Holdaway, Hyslop, Jensen, Keck, Look, McBride, Murakami, Nishida, Pemberton, Rosa, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Messrs. J. W. Enke and L. E. Taylor; Capt. David G. Hall, Lt. E. Morton Miller and Capt. Franklin Sherman III.

The following resolution, presented by Mr. Zimmerman, was unanimously approved:

WHEREAS: On June 7, 1944, Mr. O. H. Swezey celebrated his seventy-fifth birthday, and

WHEREAS: On June 9, 1944, the honorary degree of Doctor of Science was bestowed upon him by the University of Hawaii, therefore

BE IT RESOLVED: That the Hawaiian Entomological Society hereby express its sincere best wishes and greetings on the celebration of his natal day, and

BE IT FURTHER RESOLVED: That hearty congratulations be extended to him by the Society for the honors bestowed by the University of Hawaii in recognition of his outstanding record and achievements in Hawaiian entomology, and

BE IT FURTHER RESOLVED: That a copy of these resolutions be spread upon the minutes of the Society.

To this manifestation of friendly esteem Dr. Swezey responded appropriately.

Dr. D. D. Jensen was unanimously elected a member of the Society. Mr. Faxon nominated Capt. David G. Hall for membership in the Society.

### PAPERS

Dr. Swezey presented a paper entitled: "Location of Type Specimens of *Trioza koebelei* Kirkaldy (Homoptera, Psyllidae)". Dr. Holdaway presented a paper with the title: "Research on DDT for the Control of Agricultural Pests in Hawaii". Dr. Williams pre-

sented, for N. L. H. Krauss, a paper entitled: "Notes on some Hawaiian Insects".

#### NOTES AND EXHIBITIONS

*Podagrion* sp.—Mr. Bianchi reported finding egg cases of the common mantid, *Tenodera angustipennis* Saussure, in the vicinity of Hilo, Hawaii, which showed the emergence holes of this calimomid parasite. This is a new record for the island of Hawaii.

*Myzus ornatus* Laing—Mr. Krauss sent in a note to report the capture of this aphid on an unidentified composite plant at 6300 feet elevation on Hualalai, Hawaii on April 20, 1944. This is the first record of this species in these islands. Identification was made by Dr. E. O. Essig. The insect was described (Ent. Mon. Mag., 68: 52, 1932) from specimens collected near Dawlish, Devon, England, where it occurred on violet plants, causing curling of the leaves and white spotting of the flowers.

*Leiolepisma hawaiiensis* Loveridge—Dr. Swezey reported finding quite a concentration of the eggs of this recently described<sup>5</sup> skink in his garden. They were found beneath trash when he was cleaning up weeds in a neglected flower bed. There were 55 eggs in close contact in a space no larger than the palm of one's hand; others were scattered, partially in the soil, so that altogether, within the space of a foot, there were 111 of the eggs. Apparently a number of the female skinks must have resorted to this particular spot for oviposition. The eggs were retained and the young skinks liberated on hatching; the last to hatch were on July 10. The adults were very common in the garden and also about the garbage pail where drosophilid flies were very numerous, forming, no doubt, a considerable portion of the skinks' diet.

*Orphinus terminale* (Sharp)—Dr. Swezey called attention to the transfer by G. J. Arrow of *Cryptorhopalum terminale* Sharp and *C. brevicorne* Sharp, to the genus *Orphinus* (Ann. Mag. Nat. Hist. [8] 15: 438, 1915). Both species were described from Hawaii. This change of genus was recently pointed out by H. S. Barber when specimens were sent to the U. S. Bureau of Entomology for determination. The specimens of *O. terminale* were reared from old mantid oothecae collected from fence posts, etc., at the Experiment Station, H.S.P.A., Honolulu, February 14, 1944. The beetles matured on various dates between March 27 and May 1.

*Scymnus (Pullus) uncinatus* Sicard—Dr. Swezey reported that in determining for Mr. Krauss some insects collected on the island of Hawaii, eight specimens of this ladybird beetle were found. They were collected by miscellaneous sweeping at Holualoa, Kona, April 22 and 24, 1944. The specimens were identified by comparison with others in the Board of Agriculture collection which

<sup>5</sup>Proc. Biol. Soc. Washington, 52: 1, 1939.



were of the lot described by Dr. Sicard (Ann. Mag. Nat. Hist. [9] 14: 532, 1924). *S. unicinctus* is one of the species of mealybug enemies introduced from Mexico by H. T. Osborn in 1922, and reared for distribution here by the Board of Agriculture. This is the first published record of its having become established in Hawaii. However, there are earlier captures: three specimens in the Experiment Station, H.S.P.A. collection, were taken by Pemberton, May 19, 1941, feeding on *Pseudococcus brevipes* (Cockerell) on a *Gliricidia* tree at his home on Manoa Road, Honolulu. There is also a specimen, of apparently this same species, collected by Dr. Swezey, feeding on *Pseudococcus filamentosus* (Cockerell) on *Ceratonia* tree at Moanalua, Honolulu, March 30, 1927.

*Dermestes vulpinus* Fabr. and *D. cadaverinus* Fabr.—Drs. Holdaway and Jensen exhibited rabbit skins severely damaged by these two species of hide beetles, together with adult specimens of the insects. Mainland fur felt manufacturers are experiencing a shortage of fur, and are desirous of securing all the rabbit skins that may be available in Hawaii. Local rabbitries have forwarded rabbit skins by airplane to manufacturers for approval. On arrival the skins were found to be seriously injured by the dermestids, although the fur was reported otherwise of good quality. On investigation of the problem here it was found that the skins are dried for four days before shipping. During that time they become heavily infested with adults of the hide beetles, and to a less extent by the tapestry moth (see note following). From a package of 36 hides recently examined, over 1100 adult beetles were removed, an average of over 30 beetles per hide. This infestation had been acquired in four days. Studies are in progress to determine a satisfactory method of controlling and protecting the skins. Two recommendations will be made: 1, to screen the places where the skins are dried, and 2, to treat the skins as they are packed for shipment with a satisfactory cheap material to be determined by studies now in progress.

*Trichophaga tapetzella* (Linn.)—Dr. Jensen exhibited adults of the tapestry moth, reared from a rabbit skin caged for the purpose of studying an infestation of hide beetles. This is the first record of the occurrence of this moth in the Hawaiian Islands. According to the literature reviewed, the larvae of the tapestry moth may be found in the nests of birds of prey, as well as in fur and textile establishments and in private homes. Its food includes clothing, carpets, tapestry, upholstery, felts, skins, wool and hair. It seems to prefer coarser materials than the other clothes moths.

A rabbit skin infested with hide beetles was wrapped in paper and placed in a glass rearing jar, May 4, 1944. On June 29 several adults of the tapestry moth were observed to have emerged. Three adult moths were alive, two were dead, and there was evidence that several others had emerged, died and been eaten by

hide beetles or ants. One empty cocoon, with a little rabbit hair attached, was found adhering to the wrapping paper. Another, containing a live pupa, was found inside one of the feeding tubes or galleries made of rabbit hair, which the larvae construct as they feed. According to one author, this feeding tube is sometimes tied, as in the case of the webbing clothes moth (*Tineola biselliella* [Hummel]), and sometimes carried as is done by the casebearing moth (*Tinea pellionella* Linn.). In the present instance the feeding tube, which was 15 mm. long and 2 mm. in diameter, was found protruding from one of the holes made by the dermestid larvae in the wrapping paper around the rabbit skin. This tube was removed from the package and placed in a glass vial; on July 3 the moth emerged. The pupal case was left protruding two-thirds of its length from the feeding tube. By July 10 another moth had emerged from a similar feeding tube extended through a hole in the hide.

*A new hydrophilid beetle*—Mr. Pemberton exhibited a hydrophilid beetle<sup>6</sup> found by him in quantity in rotting cactus plants at Waimea, Kauai, May 24, 1944. It apparently has never been previously collected in Hawaii, and is quite different from any of the other hydrophilid species previously known in the Territory.

#### AUGUST 14, 1944

The 464th meeting was held at the H.S.P.A. Experiment Station on Monday, August 14, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Faxon, Fullaway, Hyslop, Jensen, Keck, Look, McPhail, Murakami, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Mr. J. W. Enke; Lts. W. M. Herms and E. M. Miller, and Capt. Franklin Sherman III.

Capt. David G. Hall was unanimously selected to membership in the Society.

#### PAPER

Mr. Bianchi presented a paper entitled: "Notes on the Abundance of the Spiders *Latrodectus mactans*, *L. geometricus* and *Argiope avara*, and of their Parasites on the Island of Hawaii."

#### NOTES AND EXHIBITIONS

*Myzus ornatus* Laing—Mr. Zimmerman reported that he found this species on celery in Honolulu, February 29, 1944; the identifi-

<sup>6</sup>Subsequently identified as *Dactylosternum dispar* (Sharp); see p. 233.

cation by Dr. Essig has only just now been received. Mr. Krauss recently (see p. 225) found this aphid on the island of Hawaii, but the present record from Oahu is the earliest known collection of the species in the Territory. Mr. Zimmerman also exhibited specimens of *Pseudococcus brevipes* (Cockerell) on sea grape (*Coccoloba uvifera* Linn.).

*New or rare insect records for Hawaii*—With reference to a New Jersey mosquito trap exhibited by Lt. Herms, Mr. Van Zwaluwenburg presented the following: Since July of this year Lt. Herms and T. C. Russell have been collecting insects at light traps located at the Naval Air Station, Honolulu, and at Pearl City, Oahu. Their captures have resulted in records of unusual local interest. On the night of August 9, near the fire station at Pearl City, there were captured seven specimens of a species of Ephemerida, an order new to the Territory; on August 10 three more were collected at the same place. Dr. Swezey identifies them as *Caenis* sp. (family Caenidae). Some days earlier (July 29) two specimens of the same insect were found by Mr. Pemberton among material collected from an eastbound plane arriving at Honolulu; presumably these had entered the plane after its arrival here.

Among the chironomid flies taken at the Naval Air Station, Dr. Williams finds a species of *Chironomus* not known here before, and as yet unidentified. Hitherto only two species of *Chironomus* have been known here, one, *C. hawaiiensis* Grimshaw, with definite bands on the legs, the other, a dusky-winged unidentified species from Molokai (Williams, Proc. Haw. Ent. Soc., 12: 158, pl. figs. 14B, 18, 19, 1944).

Also of interest is the capture of an adult elaterid beetle native to the American mainland, *Aeolus mellilus* (Say) var. *comis* (LeConte), at the Naval Air Station, July 24-25. This is the second specimen of this insect recorded from Hawaii; the first was collected at Nanakuli, Oahu by Neil Macintyre on June 16, 1935 (Proc. Haw. Ent. Soc., 9: 141, 1936). There is no evidence that the species is established here.

*Ampulex compressa* (Fabr.)—Mr. Pemberton reported that this wasp, introduced from New Caledonia by Dr. Williams in 1940, and parasitic on cockroaches of the genus *Periplaneta*, had been found established on Kauai about August 1, 1944. Liberations were made on that island in March 1942.

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## SEPTEMBER 11, 1944

The 465th meeting was held at the H.S.P.A. Experiment Station, on Monday, September 11, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Carter, Faxon, Fullaway, Holdaway, Jensen, Keck, Look, McBride, Nishida, Pemberton, Rosa, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Lt. E. M. Miller; Mr. Eugene Ray.

#### NOTES AND EXHIBITIONS

*Karnyothrips melaleuca* (Bagnall)—Dr. Carter called attention to the fact that this name should be used for *Dolerothrips carteri* Watson. This latter name was never published, but has been used locally (Proc. Haw. Ent. Soc., 8: 44, 1932) for a species found on pineapples. Dr. J. R. Watson recently wrote Dr. Carter that he had used the name in correspondence, but before his description was published he discovered that *D. carteri* was identical with *K. melaleuca*.

Distribution of *Culex quinquefasciatus* Say in relation to salinity of water—Lt. Miller presented the following note: Samples of water from localities in which this night mosquito was living normally on the island of Maui, were tested for sodium chloride content. Other localities in which larvae were absent were likewise sampled. Salinity of the water was determined by titration against silver nitrate, according to the method used by Robert Hughes of Hawaiian Commercial & Sugar Co., Ltd. Random samples were kindly checked by that chemist.

#### Salt Content in Grains per Gallon

Samples in which larvae were living and developing	Samples in which larvae were dead or absent
12	8
14	24
18.4	48
23.3	94
57	147
66	169
113	256
120	258
120	316
120	440
143	626
182	
313 (1st and 2nd instars)	
334 (? not checked)	

During the same period larvae of all stages were placed in known dilutions of sea water. Behavior and development were apparently normal in 30 per cent of sea water, but specimens died within 12 hours in 40 per cent sea water. At least 1000 specimens were involved in the observations. Specimens of *Aedes aegypti* (Linn.)

and *A. albopictus* (Skuse) were taken in water containing 182 grains of salt per gallon.

*Apanteles carpatus* (Say)—Mr. Fullaway reported that according to Dr. C. F. W. Muesebeck of the U. S. National Museum, *Protapanteles hawaiiensis* Ashmead, the braconid parasite of the case-bearing tineid (*Tineola uterella* Walsm.), is a synonym of *Apanteles carpatus*.

## OCTOBER 9, 1944

The 466th meeting was held at the H.S.P.A. Experiment Station, on Monday, October 9, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Faxon, Jensen, Murakami, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Mr. C. E. Cooley.

It was unanimously voted to send to the Zoological Society of London, \$50 to help in the publishing of the Zoological Record.

## PAPERS

In behalf of C. J. Drake and M. Poor Hurd of Ames, Iowa, Mr. Zimmerman presented a paper entitled: "Notes on Two Fijian Tingitids (Hemiptera)". Mr. Zimmerman presented his own paper with the title: "New Ampagia Weevils from New Caledonia and the Philippines (Coleoptera, Curculionidae)"; Mr. Bianchi presented a paper entitled: "Introduction to the Thysanoptera of New Caledonia".

*New host of pepper weevil and of lantana butterfly*—Mr. Nishida recorded the rearing of *Anthonomus eugenii* Cano and *Thecla echion* (Linn.), from the Paraguay nightshade, *Solanum rantonnettii* Carr., which is not only a new host record, but a new plant record for the Territory. According to Miss Marie C. Neal, botanist of the Bishop Museum, who identified the plant, it has never been recorded here before, although the person in whose yard (near Smith street, Honolulu) it was growing, says it has been present in one part or another of the yard since 1918. The infestation by pepper weevil was very heavy, and a large percentage of the flower buds were being shed by the plant. Of 100 unopened flower buds picked at random from the plant, 87 per cent contained *Anthonomus* larvae. This partially, at least, accounts for the fact that while flower buds were numerous, there were comparatively few open flowers. A few *Thecla* larvae were present on the plant.

*Graptostethus servus* (Fabr.)—Dr. Swezey reported that a specimen of this lygaeid bug had been collected in a house in Waianae village in September. This is apparently a new record in the spread

of this insect on Oahu. A few specimens were collected in August at Kuliouou, where they were hiding in trash on the ground.

### NOVEMBER 13, 1944

The 467th meeting was held at the H.S.P.A. Experiment Station, on Monday, November 13, at 2:00 p.m., with President Faxon in the chair.

*Members present:* Messrs. Bianchi, Faxon, Fullaway, Jensen, Murakami, Nishida, Pemberton, Rosa, Sakimura, Schmidt, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

### PAPER

Dr. Swezey presented a paper entitled: "Notes on *Graptostethus servus* (Fabr.) in Hawaii (Heteroptera, Lygaeidae)".

### NOTES AND EXHIBITIONS

*Micromyzus formosanus* (Takahashi)—Dr. Williams presented the following note for Mr. Look, now a resident of the island of Hawaii: This onion aphid was collected at the Kilauea nursery on October 6, 1944, the first record of the species on the island of Hawaii. However, a black aphid, in all probability this species, had been observed earlier to attack onions in Kona, Kau and Kohala (on Hawaii); a field of onions in Kohala was severely damaged by it in 1942.

*Myelois ceratoniae* Zeller—Dr. Swezey reported a larva of this phycitid moth was found feeding on seeds of "wiliwili" (*Adenanthra pavonina* Linn.). His granddaughter, Dorothy, found it while shelling seeds from the ripe pods. It is the first record of the moth from this host-plant. It has been reared from several other leguminous seeds: tamarind, pigeon pea, *Acacia farnesiana* (Linn.) Willd., *Erythrina*, algaroba, as well as from *Ricinus* and cotton.

*DD-mixture against termites*—Dr. Schmidt reported the successful use of DD (1, 2 dichloropropane—1, 3 dichloropropene) against dry-wood termites (*Cryptotermes piceatus* Snyder). Runways in his home treated with the liquid mixture, show no recurrence of termite infestation up to the present time, while others treated by a commercial exterminator employing ortho-dichlorobenzene, have not shown perfect control.

*Eriococcus coccineus* Cockerell—Mr. Pemberton said that this scale insect, previously reported on cactus in a garden at Koloa, Kauai (see p. 224) was found, on November 10, to have overrun the garden to the extent of obscuring certain parts of it. Plants affected were cacti of the genera *Echinopsis*, *Mammillaria*, *Cereus*,

*Cleistocactus* and *Astrophytum*, together with wild "akulikuli" (*Portulaca* type).

*Insects on Mt. Kaala*—Mr. Bianchi spoke of a collecting trip with Messrs. Van Zwaluwenburg and Williams on November 2nd to the summit of this mountain (elev. 4030 ft.), the highest on Oahu. Among the interesting captures were the immigrant lygaeid bug, *Graptostethus servus* (Fabr.); the two braconids recently introduced from Texas to attack the nutgrass armyworm: *Meteorus laphygmae* Viereck and *Apanteles marginiventris* (Cresson); a caterpillar feeding on the leaves of *Byronia*; a *Nesotochus* weevil larva parasitized by what was probably a species of *Sierola*; and various species of thrips.

*Heterocrossa crinifera* Walsm.—Dr. Swezey reported rearing this moth from larvae infesting the fruit clusters of *Broussaisia*, collected by Mr. Van Zwaluwenburg on Mt. Kaala, November 2. Ten moths were reared. This is the first record of this moth from this fruit, as well as the first record of *Broussaisia* fruits being infested by caterpillars. The moth was previously reared from fruits of *Kadua grandis* Gray on Mt. Tantalus.

*Phygadeuon* sp.—Mr. Fullaway exhibited two species of this ichneumonid genus, taken on Kauai by Mr. Krauss. One is the unidentified species previously bred from the puparium of the syrphid fly, *Lathrophthalmus arvorum* (Fabr.) by Dr. Williams (Proc. Haw. Ent. Soc., 8: 233, 1933). The other is a species new to the Islands.

## DECEMBER 11, 1944

The 468th meeting was held at the H.S.P.A. Experiment Station, on Monday, December 11, at 2:00 p.m., with President Faxon in the chair.

*Members present*: Messrs. Bianchi, Carter, Faxon, Fullaway, Ito, Jensen, Keck, Murakami, Nishida, Pemberton, Sakimura, Schmidt, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors*: Lt. E. M. Miller, and Lt. R. M. Bohart.

This being the annual meeting, a slate of officers to serve during the coming year was presented by the executive committee. There being no further nominations, the following officers were unanimously elected:

President.....	Dr. D. D. Jensen
Vice president.....	N. L. H. Krauss
Secretary-treasurer.....	Dr. F. X. Williams
Additional members of executive committee.....	
.....	Richard Faxon and Dr. Walter Carter

## PAPERS

Mr. Sakimura presented a paper by himself and N. L. H. Krauss, entitled: "Collections of Thrips from Kauai and Hawaii"; Dr. Swezey presented a paper: "Podagrion mantis Ashm., a Parasite of Mantis Eggs in Hawaii (Hymenoptera, Callimomidae)"; Mr. Bianchi presented a paper entitled: "Notes on Hawaiian Thysanoptera, with Description of a New Species"; Dr. Williams presented his paper: "The Aculeate Wasps of New Caledonia, with Natural History Notes".

## NOTES AND EXHIBITIONS

*Thrips infesting edible fungus*—Mr. Nishida presented the following note for Dr. Holdaway: Specimens of thrips, *Hoplothrips flavitibia* Moulton, were exhibited, collected by B. Kumabe on the edible fungus, *Auricularia* sp. (commonly known as "pepeiao") at Waikapu, Maui on April 6, 1944. This thrips, identified by Mr. Sakimura, was breeding freely on this fleshy fungus, growing on dead logs on recently cleared damp forest land.

*Dactylosternum dispar* (Sharp)—Mr. Pemberton said that the hydrophilid, mentioned at a previous meeting found in decaying cactus plants on Kauai and Oahu, has been determined by L. L. Buchanan as the above species. It was originally described<sup>7</sup> by David Sharp from three specimens taken in *Opuntia* refuse at Guanajuato, Mexico.

*Achaea janata* (Linn.)—Dr. Williams exhibited a specimen of this large noctuid moth which he caught on the grounds of the Experiment Station, H.S.P.A. on December 1, 1944. A short time previously he found a small dark caterpillar which was probably this species on weeds in the same locality, while in the middle of November 1944 he took a full-fed larva in his garden in upper Keeaumoku street. This caterpillar soon spun up and produced a pupa which Dr. Swezey identified as that of this moth. This is the first record in Hawaii of this species, which is widespread in the tropical and subtropical Pacific and Australia, and in the Orient. The caterpillar is polyphagous. Dr. Swezey reared it on *Rosa* sp. on Guam in 1936. Torrey Lyons found it on Wake island where it fed on *Cordia subcordata* Lamarck; it was also bad there on cultivated tomatoes. Langford and Van Zwaluwenburg reared it from *C. subcordata* on Canton island. In Samoa it is known to feed on *Euphorbia hirta* Linn., a very common weed, while Hampson (Cat. Lep. Phal., 12: 537, 1913) records *Ricinus communis* Linn. as a food plant. This moth has been found dead on airplanes arriving at Honolulu from the west.

President Faxon delivered the annual presidential address entitled: "Some Phases of Federal Plant Quarantine Work in Hawaii".

<sup>7</sup>As *Cyclonotum dispar* in Biol. Centr.-Amer., Ins., Col., 1(2): 95, 1882.





## New or Little-Known Tipulidae from New Caledonia (Diptera)

By CHARLES P. ALEXANDER

Massachusetts State College  
Amherst, Massachusetts

(Presented at the meeting of June 12, 1944)

OUR KNOWLEDGE of the crane-flies of New Caledonia is still very incomplete. The first collections made in the island were by Professor and Mrs. Cockerell, representing six species (Alexander, 1929).<sup>\*</sup> Later a few additional species were secured by Professor Jean Risbec, of the Ecole Frédéric Surleau, Noumea (Alexander, 1934 a, 1934 b) bringing the total list to nine species. In May 1940, Dr. F. X. Williams was sent to New Caledonia by the Hawaiian Sugar Planters' Association in order to investigate the insect pests of agricultural and medical importance, particularly in their future relations to the Hawaiian Islands (Williams, 1943). Although busily engaged in this economic survey, Dr. Williams secured no fewer than twelve species of crane-flies, of which nine were additions to the list as then known. The species now known from New Caledonia may be listed as follows:

## Tipulinae

- Macromastix* (*Macromastix*) *caledoniana* Alexander (1934-b).  
*M. (M.) cockerellae* Alexander (1929).  
*M. (M.) novocaledonica* Alexander (1929).  
*M. (M.) productifrons* sp.n. (this report).  
*M. (M.) risbeci* Alexander (1934-b).

## Limoniinae

## LIMONIINI

- Limonia* (*Dicranomyia*) *illingworthi* (Alexander) (1929; this report).  
*L. (Thrypticomysia)* *subsaltens* (Alexander) (1929; this report).  
*L. (Idioglochina)* *tusitala novocaledonica* (Alexander) (1929; this report).  
*L. (Geranomyia)* *circipunctata* (Brunetti) (this report).  
*L. (G.) conjuratus* sp.n. (this report).  
*L. (Libnotes)* *notata* (van der Wulp), var. (this report).  
*Helius* (*Helius*) *neocaledonicus* sp.n. (this report).  
*Orimarga* (*Orimarga*) *risbeci* Alexander (1934-a).

## HEXATOMINI

- Gynoplistia* (*Paralimnophila*) *neocaledonica* sp.n. (this report).

<sup>\*</sup>The references are cited in the short bibliography at the end of the introduction.  
 Proc. Haw. Ent. Soc., Vol. XII, No. 2, June, 1945.

*G. (Gynoplistia) williamsiana* sp.n. (this report).

#### ERIOPTERINI

*Gonomyia (Idiocera) cockerelli* Alexander (1929).

*Gonomyia (Lipophleps) novocaledoniae* sp.n. (this report).

*Erioptera (Trimicra) pilipes* (Fabricius), var. (this report).

All types of the new species and representatives of other species have been returned to Dr. Williams for inclusion in the collection of the Hawaiian Sugar Planters' Association Experiment Station, Honolulu. Duplicates are retained in my collection of these flies. I am very deeply indebted to Dr. and Mrs. Williams for the privilege of studying this small but important series of Tipulidae.

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1929. New or little-known Tipulidae from New Caledonia and Samoa. *Encycl. Entomol., Diptera*, 5: 83-92, 8 figs.

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1934-a. New or little-known Tipulidae from Eastern Asia (Diptera), XIX. *Philippine Journ. Sci.*, 54: 309-342, 3 pls.

1934-b. New or little-known Tipulidae from Eastern Asia (Diptera), XX. *Ibid.*, 54: 433-471, 2 pls.

Williams, F. X.

1943. Mosquitoes and some other noxious flies that occur in New Caledonia. *The Hawaiian Planters' Record*, 47: 205-222, 15 figs.

#### RECORD OF SPECIES

##### **Macromastix (Macromastix) productifrons** sp.n.

Size relatively large (wing, female, 13 mm. or more); general coloration of body obscure brownish yellow, the praescutum with four scarcely differentiated stripes; thorax unusually glabrous; antennae 15-segmented; front long-produced; wings yellow, stigma oval, darker brown, veins glabrous.

*Female*.—Length, including frontal prolongation, about 10-10.5 mm.; wing, 13-14 mm.; frontal prolongation alone about 2 mm.; antenna, 1.8-2 mm.

Front unusually produced, the prolongation about one-third longer than remainder of head, obscure yellow, infuscated above, more blackened near apex; entire prolongation with short but very abundant setae, the remainder of head glabrous or nearly so; no nasus; palpi dark brown, terminal segment a little shorter than the three basal segments combined. Antennae (female) short, 15-segmented, the outer two segments more or less fused; flagellar segments cylindrical, the outer ones shorter; verticils shorter than the segments. Head orange; anterior vertex, immediately behind the antennae, with a small but conspicuous conical tubercle; a dark median vitta extending from the tubercle backward, becoming very narrow behind and finally obsolete at near midlength of the posterior vertex.

Pronotum yellowish brown. Mesonotum with the ground obscure brownish yellow, the praescutum with four very poorly differentiated darker stripes that are very indistinctly bordered by still darker brown; vestiture of interspaces reduced to scattered small yellow setae; posterior sclerites of notum slightly darker brown, virtually glabrous. Pleura yellow. Halteres brownish yellow, the base of stem a trifle brightened. Legs with the coxae and tro-

chanters pale yellow; remainder of legs yellow, the outer tarsal segments more blackened; tips of tibiae very narrowly and vaguely darkened. Wings (pl. XII, fig. 1) with a yellowish tinge; stigma oval, darker brown; cell *Sc* a trifle darker than the ground; veins brown. Veins unusually glabrous, including those beyond the cord. Venation: *Rs* relatively long, exceeding  $R_{2+3}$ ;  $m-cu$  at fork of  $M_{3+4}$ , or slightly beyond on the base of  $M_4$ ; petiole of cell  $M_1$  longer than  $m$ ; basal section of  $M_{1+2}$  unusually transverse, virtually in alignment with the anterior cord.

Abdomen chiefly obscure brownish yellow, the intermediate segments yellowish brown to dark brown; sternites clearer yellow. Ovipositor with all valves very short and inconspicuous; both cerci and hypovalvae compressed, the former nearly circular in outline.

*Holotype*, ♀, Nepoui Valley, August 1940 (Williams). *Paratopotypes*, 3 ♀♀.

The most similar species in New Caledonia, and the only other one having the front at all produced, is *Macromastix* (*Macromastix*) *novocaledonica* Alexander, which is much smaller, with the front less produced, and with the details of coloration and venation of the wing distinct. By my key to the species of *Macromastix* in New Caledonia (Philippine Journ. Sci., 54: 443; 1934), the present fly runs to *novocaledonica*.

***Limonia* (*Dicranomyia*) *illingworthi* (Alexander)**

*Dicranomyia illingworthi* Alexander; Ann. Ent. Soc. America, 7: 239-240; 1914.

*Limonia* (*Dicranomyia*) *illingworthi* Alexander; Encycl. Entomol., Diptera, 5: 89-90, fig. 8 (♂ hypopygium); 1929.

Noumea, July 6-August 23, 1940; St. Louis, 1940 (F. X. Williams).

***Limonia* (*Thrypticomys*) *subsaltens* (Alexander)**

*Dicranomyia subsaltens* Alexander; Ann. Mag. Nat. Hist., [9] 13: 34-35; 1924.

*Limonia* (*Thrypticomys*) *subsaltens* Alexander; Encycl. Entomol., Diptera, 5: 88; 1929.

Noumea, August 29, 1940 (Williams).

***Limonia* (*Idioglochina*) *tusitala novocaledonica* Alexander**

*Limonia (Idioglochina) novocaledonica* Alexander; Encycl. Entomol., Diptera, 5: 90-91; 1929.

Nakety, on sea reef, October 9, 1940 (Williams).

***Limonia* (*Geranomyia*) *circipunctata* (Brunetti)**

*Geranomyia circipunctata* Brunetti; Fauna British India, Dipt. Nematocera 390; 1912.

Noumea, August 23, 1940, at light (Williams); pinned with a female *Limonia* (*Dicranomyia*) *illingworthi*. Differs from typical *circipunctata* in having the tips of the femora and tibiae unblackened, the wing pattern very restricted, and with the edge of the

mesal-apical lobe of the gonapophysis microscopically serrulate. Later described species, as *decemguttata* de Meijere (Java) and *venustithorax* Alexander (Australia), were placed in the strict synonymy of *circipunctata* Brunetti (British India) by Edwards, but all such should be re-examined for subspecific distinctions.

### *Limonia* (*Geranomyia*) *conjuratoides* sp.n.

Allied to *conjurata*; general coloration brownish black; antennal flagellum strongly nodulose, the segments narrowed at both ends, provided with very long verticils; wings with a strong brownish tinge, restrictedly patterned with still darker brown, including a series of four costal areas; basal section of  $Sc_2$  preserved; vein  $R_1$  very long, subequal to  $R_{2+3}$ ; male hypopygium with the tergal lobes produced into slender spinous points; ventral dististyle with the main body oval; a single rostral spine, from a cylindrical tubercle; gonapophyses with a strong lateral spine, additional to the gently curved mesal-apical spine.

*Male*.—Length, excluding rostrum, about 7 mm.; wing, 7.7 mm.; rostrum, about 2.2 mm.

Rostrum at base unusually thick and deep, yellowish brown, the enlarged portion a little longer than the remainder of head; remainder of rostrum (labial palpi) brown, the short tips suddenly narrowed, yellow; maxillary palpi black. Antennae black; flagellar segments strongly narrowed at incisures and there produced into short basal and apical necks, giving the antennae a beadlike appearance; verticils very strong, the longest unilaterally distributed, about twice the length of the segments, those of opposite face a little shorter. Head dark brown, sparsely pruinose; anterior vertex narrow, only about two-thirds the diameter of scape.

Pronotum black. Mesonotum dark liver-brown or brownish black, the humeral portions of praescutum a little more reddened; median region of praescutum a little more blackened in front to produce a poorly indicated stripe; postnotum slightly pruinose. Pleura dark brown, slightly pruinose; dorsopleural membrane infuscated. Halteres slightly infuscated, base of stem yellow. Legs with coxae brownish yellow; trochanters yellow; remainder of legs brown, the terminal tarsal segments more blackened; claws simple. Wings (pl. XII, fig. 2) with a strong brownish tinge, restrictedly patterned with still darker brown, as follows: A series of four costal areas, the first three more extensive than the ground interspaces, involving cells  $C$  and  $Sc$ ; second area over the supernumerary crossvein in cell  $Sc$ ; third area over the fork of  $Sc$ ; fourth area over the free tip of  $Sc_2$ ; elsewhere on disk more restricted and less evident infuscations, including origin of  $Rs$  and cord; veins brown, the central portion of vein  $R_1$  pale, representing the normal position of the otherwise unindicated stigma. Venation:  $Sc_1$  ending about opposite one-fifth the length of  $Rs$ ,  $Sc_2$  a short distance before origin of latter; supernumerary crossvein in cell  $Sc$  at near midlength of distance between  $h$  and tip of  $Sc_1$ ;  $R_1$  unusually long, as in *conjurata*, subequal in length to  $R_{2+3}$  or a little less than  $Rs$ ; cell 1st  $M_2$  about as long as vein  $M_{1+2}$  beyond it;  $m-cu$  a trifle longer than distal section of  $Cu_1$ ; cell 2nd  $A$  widest opposite anal angle.

Abdominal tergites brown, more blackened laterally; posterior borders of outer segments a little paler; eighth and ninth tergites paler, the remainder of hypopygium black. Male hypopygium (pl. XII, fig. 7) with the tergite, 9t, truncate across base, slightly narrowed outwardly, the caudal margin with a deep V-shaped notch, the lateral lobes produced caudad into long slender spinous points. Basistyle,  $b$ , moderately large, its total area about equal to that of the ventral dististyle; ventromesal lobe oval, with numerous long coarse setae that are nearly as long as the lobe itself. Dorsal dististyle  $a$

nearly straight black rod, the tip gently curved to a short black point. Ventral dististyle, *vd*, with the body oval, setiferous; rostral prolongation slender; a single spine, arising from a cylindrical tubercle placed at near midlength of outer face of prolongation, the spine more than one-half the length of the dorsal dististyle or subequal in length to the entire prolongation itself. Gonapophyses, *g*, appearing as flattened black plates, each at apex narrowed into a slender, gently curved spine; on margin before apex with a slightly smaller straight spinous point. Aedeagus, *a*, relatively narrow, at apex produced directly into a more slender cylindrical point.

*Holotype*, ♂, Noumea, August 23, 1940 (Williams).

Although undoubtedly related to *Limonia* (*Geranomyia*) *conjurata* Alexander (New South Wales; Barrington Tops, altitude 5,000 feet, January), the present fly is entirely distinct, particularly in the details of venation and structure of the male hypopygium, especially the simple ventral dististyle and the deeply bispinous gonapophyses.

***Limonia* (*Libnotes*) *notata* (van der Wulp), var.**

*Libnotes notata* van der Wulp; Tijdschr. v. Entomol., 21: 194, pl. 12, fig. 5; 1878.

One female, Thi valley, November 8, 1940 (Williams). Edwards expressed the belief that *L.* (*L.*) *howensis* Alexander, of Lord Howe Island, and *L.* (*L.*) *solomonis* Alexander, of the Solomons, were conspecific with *notata*, described from Sumatra. The former has the wings virtually unpatterned, while the latter is readily told by the broad, conspicuous, blackened bases of the tibiae.

***Helius* (*Helius*) *neocaledonicus* sp.n.**

Size large (wing, female, 9 mm.); rostrum unusually long and slender, black, only a little less than one-third the length of remainder of body; general coloration of body black; halteres and legs chiefly blackened, the tarsi paling to brown; wings with a strong blackish tinge, the oval stigma darker brown; *Sc*<sub>1</sub>, ending shortly before fork of *Rs*; cell 1st *M*<sub>2</sub> small, short-pentagonal, *M*<sub>3+4</sub> being only about one-third the length of vein *M*<sub>4</sub>; *m-cu* immediately before fork of *M*; valves of ovipositor unusually long.

*Female*.—Length, excluding rostrum, about 9 mm.; wing, 9 mm.; rostrum, about 2.8 mm.

Rostrum unusually long and slender, nearly one-third as long as remainder of body; palpi black. Antennae black throughout, relatively short; basal flagellar segments short-cylindrical, the verticils unilaterally distributed, on the more proximal segments stout and subequal in length to the segments; outer segments more elongate, with more delicate verticils; terminal segment a trifle longer than the penultimate. Head velvety black, narrowed behind; eyes large, with fine ommatidia; anterior vertex about one-half wider than diameter of scape.

Thorax dark brownish black to black; pretergites a little paler; median region of scutum paler; thorax with moderately abundant but unusually long and conspicuous erect black setae. Halteres blackened, base of stem narrowly paler. Legs with coxae dark reddish brown; trochanters chestnut brown; remainder of legs long and slender; femora black, their bases very restrictedly obscure yellow; tibiae black; tarsi paling into brown. Wings (pl. XII, fig. 3) with a strong blackish tinge, the oval stigma darker brown; prearcular field,

together with cells *C* and *Sc*, less heavily darkened; veins dark brown. Veins of distal half of wing, particularly beyond cord, with unusually abundant macrotrichia. Venation: *Sc* long, *Sc*<sub>1</sub> ending shortly before the fork of *Rs*, *Sc*<sub>2</sub> still longer, at its tip; *Rs* long, arcuated at origin; anterior branch of *Rs* subangulate at origin, the two branches strongly divergent at their outer ends, *R*<sub>4+5</sub> ending very close to wing tip; cell 1st *M*<sub>2</sub> small, short-pentagonal, *M*<sub>3+4</sub> only about one-third as long as vein *M*<sub>1</sub>; *m-cu* immediately before fork of *M*.

Abdomen black, including the genital shield. Ovipositor with both cerci and hypovalvae unusually elongate, the cerci very slender.

*Holotype*, ♀, Thi River Valley, November 8, 1940 (Williams).

The present fly is very different from the various species of the typical subgenus known from New Zealand, Australia and New Guinea, especially in the venation, with the unusually small cell 1st *M*<sub>2</sub>, in conjunction with the large body size and very long, slender rostrum.

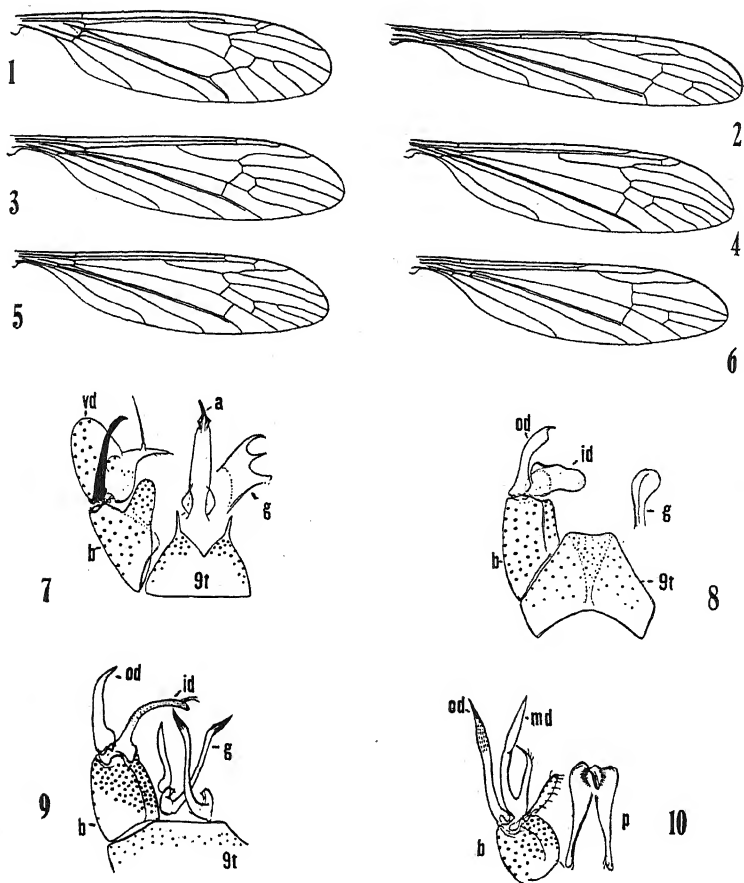
### ***Gynoplistia (Paralimnophila) neocaledonica* sp.n.**

General coloration of thorax uniformly orange, unpatterned; head black, pruinose in front; antennae 16-segmented, simple, uniformly blackened; halteres with brownish black knobs; wings brownish yellow, sparsely variegated with darker; stigma long-oval, darker brown; abdomen brownish black, the eighth and ninth segments abruptly light yellow; male hypopygium with spine of outer dististyle gently curved, the apical notch very shallow; gonapophyses appearing as relatively short rods that expand at tips into flattened, nearly hyaline blades.

*Male*.—Length, about 9 mm.; wing, 10.5 mm.; antenna, about 2.2 mm.

Rostrum and palpi black. Antennae 16-segmented, black throughout, the scape pruinose; flagellar segments oval, with truncated bases, the outer ones more narrowly joined, the segments gradually decreasing in size outwardly; terminal segment only about one-third the size of the penultimate; verticils shorter than the segments. Head black, gray pruinose on front, anterior vertex and the narrow orbits; anterior vertex approximately four times the diameter of scape.

Thorax uniformly orange, unpatterned, the mesonotum with a very sparse yellow pollen; pseudosutural foveae large but concolorous with the ground and very inconspicuous. Halteres with stem yellow, knob brownish black. Legs with coxae and trochanters orange-yellow; femora and tibiae brownish yellow, the tips narrowly blackened; basal tarsal segments brown, the terminal one more blackened; legs only moderately setiferous; claws relatively small, simple. Wings (pl. XII, fig. 4) with a weak brownish yellow ground, sparsely variegated with darker; stigma long-oval, darker brown; very restricted, somewhat paler brown seams on cord and over origin of *Rs*, most extensive on the anterior cord; veins brown, *Sc* and the prearcular veins somewhat more yellow. Venation: *Sc* long, *Sc*<sub>1</sub> ending almost opposite the fork of *R*<sub>2+3+4</sub>, *Sc*<sub>2</sub> some distance from its tip, *Sc*<sub>1</sub> alone about one-half longer than *R*<sub>2+3+4</sub>; *Rs* long, very strongly arcuated or weakly angulated at origin, in longitudinal alignment with *R*<sub>2+3+4</sub>, the latter shorter than the basal section of *Rs*; anterior branch of *Rs* relatively short, at apex deflected strongly cephalad, vein *R*<sub>4</sub> bending strongly caudad so cell *R*<sub>3</sub> at margin is unusually extensive; petiole of cell *M*<sub>1</sub> variable in length, from two-thirds to fully equal to the cell; *m-cu* from one-third to one-fifth its length beyond the fork of *M*; vein 2nd *A* sinuous.



### EXPLANATION OF FIGURES PLATE XII

- Fig. 1. *Macromastix (Macromastix) productifrons* sp.n.; venation.  
 Fig. 2. *Limonia (Geranomyia) conjuratooides* sp.n.; venation.  
 Fig. 3. *Helius (Helius) neocaledonicus* sp.n.; venation.  
 Fig. 4. *Gynoplistia (Paralimnophila) neocaledonica* sp.n.; venation.  
 Fig. 5. *Gynoplistia (Gynoplistia) williamsiana* sp.n.; venation.  
 Fig. 6. *Gonomyia (Lipophleps) novocaledoniae* sp.n.; venation.  
 Fig. 7. *Limonia (Geranomyia) conjuratooides* sp.n.; male hypopygium.  
 Fig. 8. *Gynoplistia (Paralimnophila) neocaledonica* sp.n.; male hypopygium.  
 Fig. 9. *Gynoplistia (Gynoplistia) williamsiana* sp.n.; male hypopygium.  
 Fig. 10. *Gonomyia (Lipophleps) novocaledoniae* sp.n.; male hypopygium.  
 (Symbols: a, aedeagus; b, basistyle; g, gonapophysis; id, inner dististyle; md, intermediate dististyle; od, outer dististyle; p, phallosome; t, tergite; vd, ventral dististyle.)



Abdomen brownish black, the first sternite a little more brightened at base; eighth and ninth segments abruptly light yellow. Male hypopygium (pl. XII, fig. 8) with the tergite, *9t*, large, having the characteristic conformation of the subgenus, the narrowed caudal border very gently emarginate. Outer dististyle, *od*, smooth, the spine gently curved, the apical notch very shallow. Inner dististyle very obtuse at apex. Gonapophyses, *g*, appearing as relatively short rods that expand at tips into flattened, nearly hyaline blades.

*Holotype*, ♂, Nepoui Valley, August 1940 (Williams).

*Gynoplistia* (*Paralimnophila*) *neocaledonica* is entirely different from all other species of the subgenus so far made known. Members of the group center in Australia and Tasmania, where approximately 35 species are known to date, including many with long-branched antennae. Those having simple antennae, as in the present fly, are much fewer in species in the Old World, with only three or four in Australia and two others in New Zealand (see Alexander, *Victorian Naturalist*, 1943: 89-91; October 1943). In South America, particularly Chile, rather numerous species occur, all having the antennae simple.

### *Gynoplistia* (*Gynoplistia*) *williamsiana* sp.n.

Thorax and abdomen orange, the latter with segments six and seven uniformly black; head and appendages black; antennae 16-segmented, in male with ten long-branched segments, in female with nine segments having somewhat shorter branches; wings yellow, patterned with darker; cell *M*<sub>1</sub> present; male hypopygium with both dististyles slender; inner gonapophyses appearing as strong rods, decussate across their bases, the tips acute.

*Male*.—Length, about 11-12 mm.; wing, 9.5-10 mm.; antenna, about 3.2-3.4 mm.

*Female*.—Length, about 14-15 mm.; wing, 10.5-12 mm.; antenna, about 2.5 mm.

Rostrum and palpi black. Antennae 16-segmented, black, the pedicel a trifle more piceous; in male, formula 2+3+7+4; longest branch exceeding five times the segment that bears it; branch of first segment more than twice the length of segment; terminal segment about one-third longer than the penultimate, pointed at apex. In female, antennal formula 2+9+5, the branches arranged in a gentle spiral; basal branch a little shorter than the segment; longest branch about two and one-half times the segment; terminal two segments in both sexes bearing large circular pores. Head black, more pruinose in front; anterior vertex in both sexes about twice the diameter of scape.

Entire thorax opaque orange, without clearly defined markings. Halteres with stem yellow, knob blackened. Legs with coxae and trochanters orange; femora obscure yellow, the tips blackened, more broadly so on fore legs where about the outer half is included, much narrower on posterior legs where approximately the distal quarter is darkened; tibiae and tarsi black; claws (male) at base with a row of microscopic denticles. Wings (pl. XII, fig. 5) yellow, the prearcular and costal fields a little clearer yellow; a rather conspicuous brown pattern, including the oval, dark brown stigma, and conspicuous seams at origin of *Rs*, along cord, and on outer end of cell 1st *M*<sub>2</sub>; still paler and less distinct brown washes on the longitudinal veins beyond cord and over vein *Cu*; in the paratype female, the wings are even more heavily darkened and suffused, especially along *Cu* and in the cells beyond cord; veins brown, still darker in the patterned areas. Macrotrichia of veins

relatively sparse, lacking or virtually so in outer radial and medial fields, excepting a rather abundant series on distal section of  $R_5$ . Venation:  $Sc_1$  ending about opposite one-third to one-half  $R_{2+3+4}$ ,  $Sc_2$  at its tip; cell 1st  $M_2$  rectangular, with  $m-cu$  at near midlength; cell  $M_1$  about one-half longer than its petiole.

Abdomen (male) orange, the posterior half of tergite two and distal portion of tergite three with more or less distinct dark rings; segments six and seven uniformly black, eight and nine abruptly orange-yellow. In female, the subbasal darkenings virtually lacking, with only a triangular area on sides of second tergite; pleural region weakly infuscated; subterminal black ring as in male; ovipositor and genital shield orange; valves of ovipositor elongate, cerci slender, very gently upcurved. Male hypopygium (pl. XII, fig. 9) with the tergal region,  $9t$ , transverse, its central portion a little produced, its margin truncate. Basistyle,  $b$ , stout, the apical lobes poorly developed. Both dististyles elongate, the outer,  $od$ , glabrous, from an enlarged base, gradually narrowed to an acute point; inner style,  $id$ , a little shorter, strongly curved, its apex obliquely truncate, with abundant short setulae and about two elongate setae. Gonapophyses,  $g$ , exceeding the aedeagus in length, the inner pair appearing as powerful rods, decussate near bases, expanded near tips into narrow blades, thence narrowed into powerful spines; outer apophyses shorter, appearing as narrow flattened blades, their tips acute. Aedeagus slender, its basal portion subtended on either side by an expanded flange.

*Holotype*, ♂, Saint Louis, 1940 (Williams). *Allotopotype*, ♀, October 14, 1940. *Paratopotype*, 1 broken ♂; *paratype*, ♀, Thi River Valley, November 6, 1940 (Williams).

I take great pleasure in naming this very distinct crane-fly in honor of Dr. Francis X. Williams. There is no close described relative among the host of species of *Gynoplistia* now known from New Zealand, Australia and New Guinea. The genus had not been reported from the smaller islands of Oceania. The orange thorax suggests *Gynoplistia* (*Gynoplistia*) *annulata* Westwood, of eastern Australia, but in every other respect the flies are entirely unlike.

### **Gonomyia (Lipophleps) novocaledoniae** sp.n.

General coloration brownish gray, variegated with yellow; thoracic pleura with a very conspicuous, china-white, longitudinal stripe, bordered both above and below by dark brown; halteres yellow; femora obscure yellow, the tips gradually more infuscated; wings tinged with brownish yellow, stigma faintly indicated;  $Sc_1$  ending nearly opposite or just before origin of  $R_s$ ; anterior branch of  $R_s$  gently sinuous; cell 1st  $M_2$  subequal in length to vein  $M_3$  beyond it;  $m-cu$  at the fork of  $M$ ; abdomen chiefly dark brown, the hypopygium somewhat more brownish yellow; male hypopygium with three dististyles, the intermediate one profoundly and unequally bifid.

*Male*.—Length, about 4 mm.; wing, 4 mm.

Rostrum and palpi black. Antennae with the scape and pedicel obscure yellow, more or less infuscated, flagellum black; outer segments elongate cylindrical, the intermediate ones (about three to seven) with exceedingly long verticils, as is common in males of the subgenus. Head yellow, the center of vertex slightly more darkened.

Pronotum and pretergites yellow. Mesonotum chiefly dark brownish gray, only vaguely patterned with other colors; lateral border of praescutum broadly more yellow; central region of scutum paler gray pruinose, with a darker median vitta; scutellum darker medially at base, the broad apex clearer gray.

over a pale ground; mediotergite darker on central portion, the sides and pleurotergite paler. Pleura chiefly brownish yellow, with a very conspicuous, china-white, longitudinal stripe extending from behind the fore coxae to the base of abdomen, passing beneath the root of halteres, this stripe very narrowly bordered both above and beneath by dark brown, the latter color paling gradually into the ground. Halteres yellow. Legs with the coxae testaceous yellow, the middle and posterior pairs more darkened basally; femora obscure yellow, the tips gradually more infuscated; tibiae almost uniform brownish yellow; tarsi passing into black. Wings (pl. XII, fig. 6) tinged with brownish yellow, the outer radial field slightly more infuscated; prearcular and costal fields clearer yellow; stigma oval, very pale brown, inconspicuous; veins pale brown, those in the clearer areas paler.  $Rs$  and the longitudinal veins beyond cord with abundant trichia. Venation:  $Sc_1$  ending nearly opposite to just beyond origin of  $Rs$ ,  $Sc_2$  a short distance from its tip;  $Rs$  relatively long, a trifle more than one-half its anterior branch, the latter gently sinuous; cell 1st  $M_2$  subequal in length to vein  $M_3$  beyond it;  $m-cu$  at the fork of  $M$ .

Abdomen chiefly dark brown, the incisures somewhat paler; hypopygium somewhat more brownish yellow. Male hypopygium (pl. XII, fig. 10) without a tergal setiferous comb. Basistyle,  $b$ , small, suboval in form. Three dististyles, the outer,  $od$ , a simple, nearly straight rod, at its apex narrowed into a strong black spine, the surface of distal half with microscopic setulae; intermediate style,  $md$ , profoundly and unequally bifid, the outer arm a flattened yellow blade that narrows very gradually to the acute point, the blade subequal in length to the outer style; inner arm only about one-half as long as the outer one, gradually narrowed to an acute blackened spine, the lower or inner margin with a few setae, more conspicuous shortly before the apical spine; inner dististyle elongate, fleshy, the length about four times the greatest diameter; margin with about a dozen strong setae but none of these fasciculate. Phallosome,  $p$ , stout, with widely expanded blades, before apex with fringes of yellow setae; apex of aedeagus decurved.

*Holotype*, ♂, Saint Louis, 1940 (Williams).

In the structure of the male hypopygium, the present fly differs widely from the now numerous regional species of the subgenus. It bears some slight resemblance to *Gonomyia* (*Lipophleps*) *pietatis* Alexander, of Guam and the Carolines, but the relationship is not particularly close.

**Erioptera** (*Trimicra*) *pilipes* (Fabricius), var.

*Tipula pilipes* Fabricius; Mantissa Ins., 2: 324; 1787.

*Erioptera* (*Trimicra*) *pilipes* (Fabricius) Edwards; Trans. Soc. British Ent., 5 (1): 129; 1938.

Noumea, July-August 1940; Saint Louis, October 14, 1940 (Williams).

This is one of the most puzzling crane-flies known. What appears to represent a single species occurs virtually throughout the world, including the remote oceanic islands. Unless their present distribution was attained by commerce, it is very difficult to attempt an explanation of possible manners in which it could have been brought about.

Notes on the Abundance of the Spiders *Latrodectus mactans*,  
*L. geometricus* and *Argiope avara*, and of their Parasites  
on the Island of Hawaii

By FRED A. BIANCHI

(Presented at the meeting of August 14, 1944)

*Latrodectus mactans* (Fabr.) and *L. geometricus* Koch

IN June or July of 1939 reports reached entomologists of the Experiment Station, H.S.P.A. of an unusually heavy infestation of *L. mactans* at Morse Field, South Point, Hawaii. With the double object of verifying the reports and of liberating a large colony of *Baeus californicus* Pierce, the then recently introduced egg parasite of the spider, I visited Morse Field on August 22, 1939, and found that actual conditions had not been overstated in the reports. Spiders were in fact excessively abundant in the vicinity of the barracks, and at least one individual, usually more, could be found under every stone that was turned over, and within almost every clump of grass thick enough to provide a modicum of protection. The barracks themselves were festooned, inside and out, with numerous webs, and it was not difficult to understand that their annoyance to the troops had long become more than merely psychological. In short, South Point showed during August 1939 the thickest infestation of *L. mactans* that I have ever seen or read of, and provided an ideal site for the liberation of the parasites I had with me.

The liberation was made. The parasites were spread out over an area of about half an acre in the vicinity of what were then the modest barracks of a small garrison. For one reason or another, mostly on account of the relative inaccessibility of South Point, no further observation was made again until June 23, 1944.

On that date I again visited South Point and found greatly changed conditions. As it turns out, however, they are not the entirely satisfactory conditions nor the exact changes that I expected. While the population of *L. mactans* has been greatly reduced so that spiders and webs of this species can be found only with difficulty, *Latrodectus geometricus*, a closely related species not heretofore seen at South Point, has appeared upon the scene, and now completely fills the niche formerly occupied by *mactans*. *L. mactans* can still be found, a scattered spider and a few egg masses here and there under a stone or plank, but not a single spider nor an egg mass of the species is to be seen in any of the many buildings which now constitute the greatly expanded barracks. All the numerous spiders which at present enjoy the protection of Uncle Sam's roofs are of the species *geometricus*.

Following the liberation of a parasite (*Baeus*) which is known to attack the eggs of *L. mactans* only, this strikingly complete supersession of one species by the other naturally suggests great efficiency on the part of the parasite; but unfortunately, other circumstances of the case contradict this suggestion. In the first place, neither *Baeus* itself nor any evidence of its presence—other than the circumstantial evidence provided by the observed reduction of *L. mactans*—have been found in the South Point area. In the second place, even if the parasite were definitely known to be established in the area, it would not necessarily follow that its work had caused the suppression of *mactans* by *geometricus*. The same result might obtain from a different cause, i.e.: better adaptation of *geometricus* to the local environment. This, in fact, I believe to be the real cause. Assumption that it is the real cause agrees with previous observations—all of a more cursory nature than the present one—which have been made from time to time by myself and my colleagues on the relative survival potential of the two species concerned. And it agrees also with the fact that *L. geometricus* was not found in South Point at the time of my first visit in 1939. The species, I believe, had not found its way into the area at that time. When it later did so, some time between 1939 and 1944, it easily displaced *L. mactans*, and would have done so regardless of the presence or absence of *Baeus*.

### **Argiope avara** Thorrel

Up to some 14 or 15 years ago *Argiope avara* was one of the most common and conspicuous invertebrates of our fields. In cane fields particularly, where the strong webs sometimes made uncomfortable the transit of men and animals, the spider was not an unmixed blessing. Then, following the establishment early in the last decade of *Tromatobia rufopictus* (Cresson), a self-introduced hymenopterous parasite, the spider practically disappeared until some four or five years ago, since when an upward trend in the population has again become evident.

It has been surmised that this reversal in population trend was due to the work of a hyperparasite of *Tromatobia*. But although the hyperparasite itself, a spalangid, *Pleurotropis wilderi* (Howard), has been known a long time and has been reported more than once in circumstances that clearly indicated the nature of its role, no direct evidence has been turned up heretofore on the actual importance of that role.

It is this evidence which I luckily ran into on June 29 of the current year, in one of the thickets of cactus plants which are to be found on the slopes immediately north of the town of Kamuela, Hawaii. It consisted, first, of hundreds of webs and egg cases of *Argiope avara*, a concentration greater than I had ever seen before, even previous to the establishment of *Tromatobia*; second, of the

corroborative evidence provided by the dissection of a representative lot selected from the great number of egg masses available. The large number of egg masses shows a very definite reduction in the efficiency of *Tromatobia rufopectus*, the primary parasite of the spider. The results of dissecting the representative lot of egg masses indicates that the reduced efficiency of *Tromatobia* must be due to the work of the hyperparasite.

The quantitative results of the dissections follow:

Total number of egg masses examined .....	55
Egg masses in which hyperparasites had developed or into which adults had crawled .....	55
Egg masses in which all primaries had been destroyed by the hyperparasite .....	46
Egg masses in which the hyperparasites had destroyed all but one or two of the primaries .....	5
Egg masses in which no primaries had been destroyed by the hyperparasite .....	1
Egg masses in which no indication of the actual or former presence of the primary parasite was found .....	2
Egg masses in which no primaries were found but in which eggs had been destroyed by some other cause (desiccation?)	1



## Introduction to the Thysanoptera of New Caledonia

By FRED A. BIANCHI

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of October 9, 1944)

THIS paper is based entirely upon collections made by Dr. F. X. Williams between July and November of 1940, in the course of an entomological survey of New Caledonia conducted under the auspices of the Experiment Station, H.S.P.A. Excepting Bagnall's description of *Docessissophothrips monstrosus* (Transactions of the Northumberland, Durham, and Newcastle-upon-Tyne Natural History Society, 3: 538, 1909), this constitutes to my knowledge the first printed mention of the thrips of that large and important Pacific island, and I consider myself very fortunate to have the chance of making it my first significant contribution to our knowledge of the Thysanoptera, a group to which for several years I have dedicated the spare time left me by other duties.

One variety and 22 species are here recorded: the variety and 14 species in the Terebrantia and eight species in the Tubulifera. Nine species, one variety, and one genus are described as new; eight species were known previously only from Australia; two are known elsewhere in the Pacific; and four are of cosmopolitan or semi-cosmopolitan distribution. Obviously this is not a long list for an island of New Caledonia's size, with a flora which is known to comprise more than 2,500 species of plants, a large proportion of them indigenous. It is a list, however, which almost certainly will grow, slowly through the accretion of native species which are bound to be discovered from time to time, and rapidly through the introduction of foreign species which must follow the accelerated tempo of postwar trade.

The affinities of the New Caledonia Thysanoptera appear now to be preponderatingly Australian. This is to be expected from the relative nearness, geographical and commercial, of the two countries, but in the state of our knowledge of the Thysanoptera in New Caledonia and in the Pacific area as a whole, it is not safe to assume that the affinities will prove exclusively Australian in the end. Since the affinities of the extensive indigenous flora of New Caledonia are twofold, Indo-Malayan and Australian, we may expect increased knowledge to show a parallel condition in the Thysanoptera, as it has already appeared in other orders.

From the viewpoint of Hawaii and the sugar industry it is interesting that of the 23 species listed, eight were collected by Dr.



Williams on cultivated *Saccharum* or wild relatives thereof. It is to be noted, however, that none of the species which are known to feed on sugar cane in other parts of the world have been found in New Caledonia; and further, that it will take more research to establish which of the New Caledonian species actually do have that habit. It is possible that some of the species which Dr. Williams collected on *Saccharum* were using the plant only as a perch, although this was probably not so in the case of species found repeatedly within the spindle of the plant.

The following tabulates for convenient reference the species discussed in this paper and their distribution:

	Known in Australia	Known elsewhere in the Pacific	Cosmopolitan or nearly so
<i>Tubulifera</i>			
1. <i>Cryptothrips dimidiatus</i> Hood.....	×		
2. <i>Gastrothrips noumeae</i> sp. nov.....			
3. <i>Scopaeothrips intermedius</i> sp. nov.....			
4. <i>Haplothrips gowdeyi</i> (Franklin).....	×	×	×
5. <i>Haplothrips angustus</i> Hood.....	×		
6. <i>Haplothrips victoriensis</i> Bagnall.....	×		
7. <i>Haplothrips victoriensis</i> Bagnall var. <i>nov. nepouiensis</i> .....			
8. <i>Podothrips xanthopus</i> Hood.....	×		
9. <i>Dichaetothrips adventor</i> sp. nov.....			
<i>Terebrantia</i>			
1. <i>Aeolothrips inauditus</i> sp. nov.....			
2. <i>Heliothrips rubrocinctus</i> (Giard).....		×	×
3. <i>Chirothrips aculeatus</i> Bagnall.....	×		×
4. <i>Scirtothrips albomaculatus</i> sp. nov.....			
5. <i>Ensiferothrips primus</i> sp. nov.....			
6. <i>Anaphothrips speciosus</i> Hood.....	×		
7. <i>Anaphothrips sweseyi</i> Moulton.....		×	
8. <i>Taeniothrips kellyanus</i> (Bagnall).....	×		
9. <i>Taeniothrips novocaledonensis</i> sp. nov....			
10. <i>Isochaetothrips seticollis</i> (Bagnall).....	×		
11. <i>Isochaetothrips insignis</i> sp. nov.....			
12. <i>Diarthrothrips saccharicolus</i> sp. nov.....			
13. <i>Thrips tabaci</i> Lindeman.....			×
14. <i>Thrips imaginis</i> Bagnall.....	×		

All the material of Dr. Williams' collecting, including types and paratypes of the new species, is deposited in the collection of the Experiment Station, H.S.P.A., Honolulu, Hawaii.

Suborder Tubulifera Haliday, 1836  
 Superfamily Phloeothripoidea Hood, 1915  
 Family Phloeothripidae Uzel, 1895  
 Subfamily Phloeothripinae Karny, 1921  
 Tribe Hoplothripinae Priesner, 1927

Genus *Cryptothrips* Uzel

Uzel, Monographie der Ordnung Thysanoptera: 230, 1895.  
 Priesner, Die Thysanopteren Europas: 484, 1927.

*Cryptothrips dimidiatus* Hood

Hood, Memoirs Queensland Mus. 6: 145, 1918.

Kelly and Maynard, Mon. of the Order Thys. in Australia: 57, 1934.

Previously known in and described from North Queensland. Three females collected by Dr. Williams on *Casuarina* at Noumea on July 21, two males and many females at Noumea or near it, by beating and without record of host plant, July and September.

Genus *Gastrothrips* Hood

Hood, Proc. Ent. Soc. Wash., 14 [3]: 156, 1912.

Hood, Revista de Entomologia (Rio de Janeiro), 5 [2]: 16, 1935.

*Gastrothrips noumeae* sp. nov. (pl. XIII, fig. D)

Female (macropterous): Length about 1.8 mm. Color by transmitted light, dark brown with only the third antennal segment, the fore-tarsi and the distal third of the fore-tibiae along its inner margin light brownish yellow. Eyes, ocellar crescents, hypodermal tissue orange-yellow. Wings almost hyaline, except base and scale of fore wing which are smoky brown.

Head about equally long as wide across middle of eyes; cheeks slightly arched and converging toward base; vertex broadly arched, slightly produced between eyes, bearing middle ocellus at apex; occiput faintly, transversely striate only on the sides and bearing few (10-12) small, weak spines. Eyes occupying a little more than a third of cheek length; the distance between them considerably greater than their diameter; their facets without pilosity between them, relatively small and uniform in size, eight or nine of them on the outer outline of the eye; their dorsal outline rounded inwardly; their ventral outline somewhat produced caudally and inwardly. Ocelli widely separated; anterior one frontally directed, on apex of vertex and slightly overhanging base of antennae; posterior pair very near inner margins of eyes, on or near a line across anterior third of eyes. A small spine forwardly directed and about an ocellar diameter in front of each posterior ocellus; a somewhat smaller spine the same distance back and slightly inward of each posterior ocellus. Postocular spines thin, sharply pointed, about equal in length to an ocular diameter and set a fourth of their length back of the eyes. Mouth cone nearly reaching hind margin of prothorax, its nearly straight sides convergent to the rounded end; the labrum blunt and not surpassing the labium.

Antennae typical of the genus, shaped as illustrated, somewhat more than twice as long as head. Segment 3 light brownish yellow, in strong contrast to the others, which are concolorous with head. Segment 3 with two sense cones, one lateral and one ventral; 4 with three sense cones, two lateral and one ventral; 5 with two lateral and one dorsal; 6 with a small outer dorsal

cone and a longer inner cone; 7 with a long dorsal cone. Segments 4 to 6 only slightly but distinctly produced on the ventral surface.

Prothorax about seven-tenths as long as head; sides diverging sharply to about middle, thence more gradually to hind margin; median pronotal suture dark, not attaining either margin; pronotal disk faintly, irregularly wrinkled but without distinct sculpturing or striation, bearing only two small, sharp setae approximate to the meson on the cephalic third of the segment, and two of the same size caudo-laterad of the first. The usual pronotal setae all present, all sharply pointed and nearly colorless; epimerals and postero-angulars about three-fourths, mid-laterals about one-half, antero-angulars about one-fourth the length of prothorax; postero and antero-marginals minute.

Pterothorax widest on anterior half, suddenly constricted in the middle and sides thence arching and converging to base. Mesoscutum weakly striated with short, transverse, curved anastomosing lines; bearing a conspicuous circular pit on either side of the meson and a series of about eight smaller pits along the posterior margin. Metascutum bearing two long (.041 mm.) sharp bristles removed from each other by somewhat more than their length and from the anterior margin of metascutum by somewhat less than their length. A rather short, thornlike spine on either side and cephalad of the narrowed anterior margin of the first abdominal segment.

Legs normal; fore femora moderately incrassate; all femora and tibiae rather sparsely setose, the setae becoming longer near the distal end of the tibiae with one particularly long seta outwardly on the intermediate and hind tibiae. Fore coxae armed outwardly with a rather thin, transparent hair about equal in length to the antero-angulars of the prothorax.

Wings long, almost hyaline except at base and scale of fore wing which are smoky brown; ciliae brownish, the fore wing bearing four to seven accessory ones; sub-basal setae colorless, proximal and distal one long and nearer fore margin of wing than intermediate one, which is minute.

Abdomen widest on segments 6 and 7, thence abruptly narrowed to base of tube. The usual bristles present, light brown and pointed; those on segment 9 almost colorless distally, quite long and thin. Tube length about equal to, sometimes a little less than, head length; width at end .6 width of base. Tube constricted near its end; its surface with scattered, very minute setae.

Measurements of female holotype in mm. (paratype in parentheses): body length 1.8 (.18); head length .184 (.184); head width .184 (.184); prothorax length .139 (.139); prothorax width (including coxae) .266 (.266); tube length .172 (.184); tube width at base .065 (.065); tube width at end .036 (.036); epimeral setae .086 (.082); setae at end of tube .192 (.205).

Antennal segments:	1	2	3	4	5	6	7	8	Total length
Type .....		.053	.697	.053	.053	.053	.036	.032	.377
Paratype .....		.049	.069	.057	.057	.057	.041	.032	.....

Male (macropterous):—Very similar in color and shape to female; differing as follows: fore femora incrassate; fore tibiae more distinctly elbowed near base and paler in color; basal segment of fore tarsi inwardly produced into a strong, broad-based, slightly recurved tooth; two unequal coxal setae, both stout, spine-like; surface of tube, at least basally, with small, more or less longitudinal raised areas which under high magnification make the surface appear rough.

Sternite of abdominal segment 9 (scale) is narrowed in its distal half and its sides become almost parallel, overlapping the base of the tube.

Measurements of male allotype in mm.: Body length 1.55; head length .172; head width .172; tube length .184; tube width at base .065; tube width at end .032; setae on abdominal segment 9 .205; setae at end of tube .189.

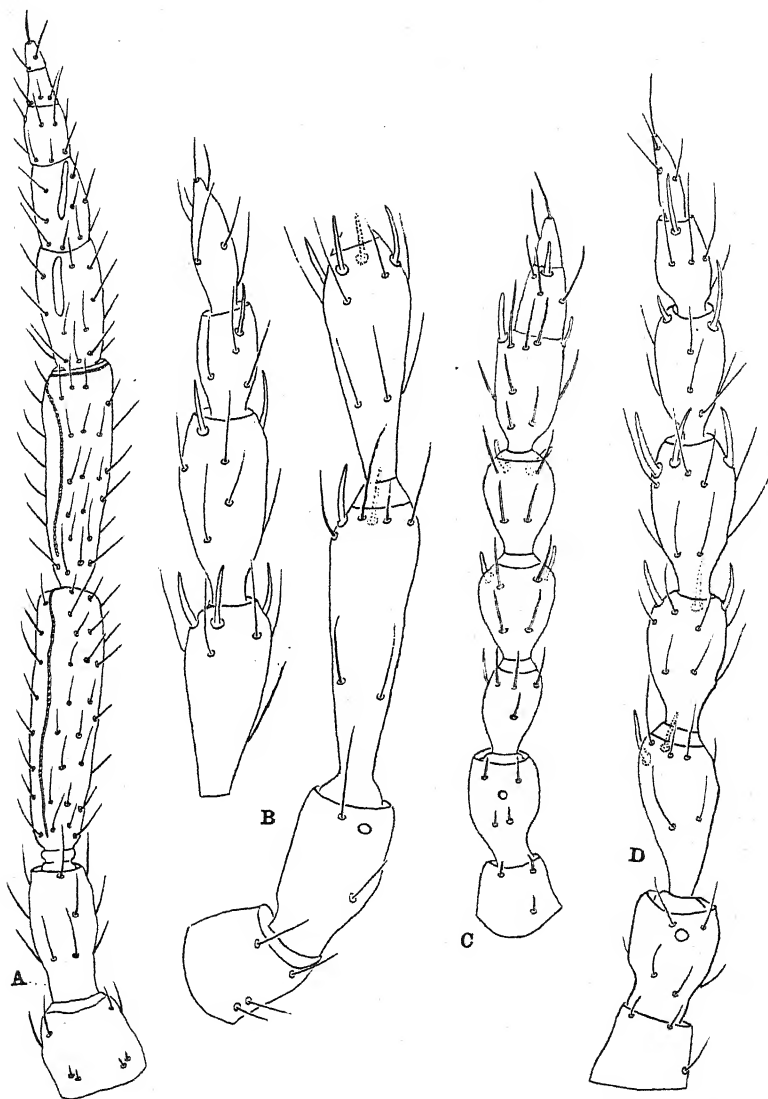


PLATE XIII

- A—*Aeolothrips inauditus* sp.n. Right antenna of female; ventral view.  
B—*Dichaetothrips adventor* sp.n. Right antenna of female; dorsal view.  
C—*Scopaeothrips intermedius* sp.n. Left antenna of female; dorsal view.  
D—*Gastrothrips noumeae* sp.n. Left antenna of female; dorsal view.

Antennal segments:	1	2	3	4	5	6	7	8	Total
..	.049	.065	.053	.053	.049	.032	.028		.354

Described from numerous males and females beaten from grass; hills back of Noumea; September 24.

In the arrangement of the sense cones and in the unarmed fore tarsi of the female, this new species seems to belong in the *abditus*, *corvus*, *capitalis* group; being nearest to *abditus* but distinguishable from it by the distinctly pointed pronotal setae and from the others of the group, as well as *abditus*, by the hyaline wings.

### Genus *Scopaeothrips* Hood

Hood, New Genera and Species of North American Thysanoptera from the South and West; Proc. Biol. Soc. Wash., 25: 61-76, 1912.

### *Scopaeothrips intermedius* sp. nov. (pl. XIV, fig. A and pl. XIII, fig. C)

Female (macropterous): Length 1.3 mm. Color by transmitted light from lemon to orange-yellow mottled with brown; tube and antennal segments 4 to 8 brown, not mottled; mesoscutum and metascutum mottled, darker than rest of body except narrowly along meson; eyes and ocellar crescents dark red. Striation distinctly reticulate on dorsum of head, metascutum, dorsum of first, second, ninth abdominal segments; on mesoscutum and other parts of body varying from semi-reticulate to transverse anastomosing lines. On sides of abdominal segments some of the striae are produced caudally into short, sharp, broad-based microtrichia visible only under high magnification. Pronotum sculptured with dark raised areas of irregular size and shape separated by pale anastomosing lines and depressions.

Head wider than long, slightly constricted back of eyes and at base; a thin, dark, sinuous line marking off a narrow collar-like area at base; cheeks weakly arched; dorsum and sides with reticulate striation which in dorso-ventral mounts under high magnification causes cheeks to appear serrate; front produced between the eyes, separated from their margins by a deep furrow and bearing the anterior ocellus at its apex; anterior ocellus smaller than posterior ocelli and these directed dorso-laterally, removed by less than one ocellar diameter from margins of eyes. Eyes occupying less than half of head length; facets uniform in size, about eight on outer outline of eye, a few small spines between them. A sharp seta about twice as long as the diameter of an ocellus back and somewhat inward of each posterior ocellus; on same longitudinal line but forward of each posterior ocellus a very minute seta; on the same transverse line as the latter but nearer the margin of each eye and outside of ocellar triangle a somewhat longer seta. Back of each eye and just laterad of its inner edge a short, thick, infundibuliform postocular seta. Over dorsum and sides many short, sharp, wide-based spines. Antennae as figured, about one and a half times the head length; three basal segments lighter in color than distal five, which are dark brown; segments 3 to 5 about equal in length but 3 always narrower than 4 or 5; segments 3 to 6 pedicellate; 7 almost perfectly cylindrical and broadly joined into a club with 6 and 8; each segment with four or five transverse striae which sometimes anastomose; each segment with two whorls of weak, short, translucent hairs, one above, the other below the middle of the segment; segment 6 bearing the longest hairs, which are about two-thirds the length of the segment. One circular sense area on dorsal surface of second segment; two sense cones

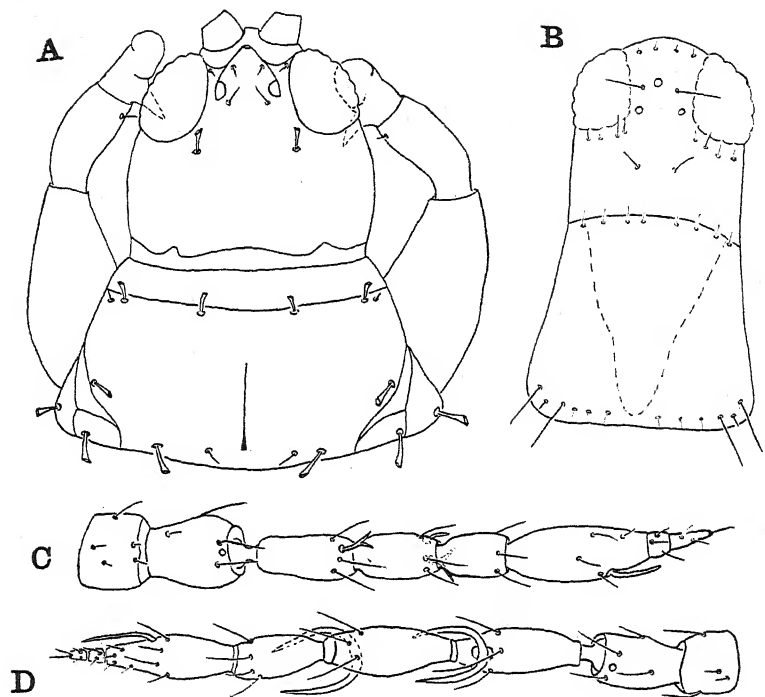


PLATE XIV

A—*Scopaeothrips intermedius* sp.n. Head, prothorax, and fore legs of macropterous female.

B—*Diarthrothrips saccharicolus* sp.n. Head and prothorax of macropterous female, with discal prothoracic setae omitted.

C—*Diarthrothrips saccharicolus* sp.n. Left antenna of female, dorsal view.

D—*Taeniothrips novocaledonensis* sp.n. Left antenna of female, dorsal view.

on each of segments 4, 5, and 6, latero-ventrad on 4 and 5, laterad on 6; one sense cone dorsad near the end of segment 7. Mouth cone short, rounded, in specimens not distended reaching almost to hind margin of prosternum; labrum abruptly narrow and dark near tip, maxillary and labial palpi two-segmented, in both cases the distal segment much longer than the basal one.

Prothorax about seven-ninths as long as head and at base much wider than head; sometimes medially depressed and with a narrow incomplete median groove; the sides diverging to about middle then parallel to hind angles; antero-angular, antero-marginal, mid-lateral, epimeral, postero-angular, and coxal setae all present, short and infundibuliform, pale in color and difficult to make out against the darker pronotum; a minute sharp seta laterad of each antero-angular and a somewhat longer sharp seta mesad of each postero-angular; some 30 or 40 minute thorns more or less symmetrically dispersed over disk and sides of pronotum. Pterothorax short, as wide as prothorax in front, narrowing slightly to hind margin, with many short, stiff thorns on meso- and metascutum and a few on the sides. Legs normal, rather short and stout, with only weak, translucent hairs, fore femora incrassate; basal segment of all tarsi with a small curved claw ventrally, and in the fore tarsi also produced inwardly into a long, strong, sharp tooth. Wings colorless, broad, not narrowed in the middle, reaching to about fifth abdominal segment in specimens not distended; the fringe long and straight, without double hairs; fore wings with three short, infundibuliform sub-basal setae.

Abdomen broad and relatively short, broadening abruptly from base to second segment, of practically unvarying width thence to segment 6; segment 7 somewhat narrower; 8 and 9 narrowing abruptly to base of tube. Bristles at angles and hind margins of all segments short, thick, infundibuliform, except middle pair of segments 2 to 7 which are wing-retaining spines, long, pointed, and inwardly curved. A row of six minute intermarginal spines on the sides of each segment, along the transverse median line, and a single, somewhat longer spine just caudad of each row are not infundibuliform. Tube less than twice as wide at base as at end and tapering evenly backwards; with a small circular porus on each side near the end; with many minute spines scattered over the surface and, on the end, with six weak, translucent hairs about two-thirds the length of the tube set between six much shorter ones.

Measurements of female holotype in mm.: Length 1.3; length of head .16; width of head .19; length of tube .12; width of tube at base .06; width of tube at end .03.

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.030	.039	.036	.036	.036	.055	.030	.018	.280

Male (macropterous): Length 1.1 to 1.4. Like the female in every respect except that the abdomen tapers gradually from segment 6 to the base of tube, and tube is somewhat shorter and relatively stouter.

Measurements of male allotype in mm.: Length of head .15; width of head .19; length of prothorax .19; width of prothorax .24; length of tube .09; width of tube at base .06; width of tube at end .03.

Antennal segments:	1	2	3	4	5	6	7	8	Total
Allotype .....	.033	.045	.036	.036	.036	.045	.030	.018	.279
Paratype .....	.033	.045	.042	.042	.042	.051	.030	.024	.309

Described from three males and one female collected by beating on *Casuarina collina* Poiss; hills back of Noumea; April 24.

This new species appears to be related to the *Rhopalothrips-Rhopalothripoides-Froggattothrips* group as well as to *Scopaeo-*

*thrips*. The club-like end of the antennae shows its affinities to the former, but the peculiarly produced front places it is *Scopaeothrips*. Hence I choose to call the species *intermedius*; and to place it in *Scopaeothrips*—in preference to erecting a new genus for this single species—I am forced to expand *Scopaeothrips* to include forms in which some antennal segments are consolidated, as well as forms in which all the segments are free and of normal form.

Tribe Haplothripini Priesner, 1927

Genus **Haplothrips** Amyot and Serville

Amyot and Serville, Hist. Nat. Ins. Hemipt: 640, 1843.

Priesner, Die Thysanopteren Europas: 564, 1927.

**Haplothrips gowdeyi** (Franklin)

1908—*Anthothrips gowdeyi* Franklin; Proc. U. S. Nat. Mus., 33: 725.

1910—*Anthothrips variabilis* Crawford; Pomona College Jl. Ent., 2 [1]: 166.

1912—*Haplothrips gowdeyi* (Franklin); Hood: Proc. Biol. Soc. Wash., 25: 62.

1918—*Haplothrips gowdeyi* (Franklin); Hood; Memoirs Queensland Mus., 6: 127.

1928—*Haplothrips gowdeyi* (Franklin); Moulton: Thys. of the Hawaiian Islands; Proc. Haw. Ent. Soc., 7 [1]: 125.

1933—*Haplothrips gowdeyi* (Franklin); Moulton: Rev. de Ent. 3 [3]: 389.

1934—*Haplothrips gowdeyi* (Franklin); Kelly and Mayne; Monograph of the Order Thysanoptera in Australia: 45.

1939—*Haplothrips gowdeyi* (Franklin); Moulton: Thysanoptera collected by the Mangarevan Expedition; Occ. Papers Bishop Museum, 15 [12]: 145.

1944—*Haplothrips gowdeyi* (Franklin); Moulton: Thysanoptera of Fiji; Occ. Papers Bishop Museum, 17 [22]: 298.

A widespread species that has been reported up to now from southern United States, Mexico, Central America, Brazil, Barbados, St. Vincent and Puerto Rico, and in the Pacific from Hawaii, Midway, Fiji, Moorea, Mangareva, Rapa and Australia.

Many males and females collected at or near Noumea during July, August, and September from *Argemone mexicana* Linn., *Ipomoea*, cucumber, in the spindle of sugar cane (two females), and one other unrecorded host.

**Haplothrips angustus** Hood

1919—Hood: Proc. Biol. Soc. Wash., 32: 77.



1934—Kelly and Mayne: Monograph of the Order Thysanoptera in Australia: 46.

Described from specimens collected on grass at Brooklyn, New South Wales.

Dr. Williams' collections were as follows: at Nepoui, August, in spindle of wild grass resembling *Saccharum*, five females; on sugar cane, two females and one male; at Noumea, August 23, in spindle of sugar cane, one female; September 27, in spindle of sugar cane, one female; August, on sugar cane, one male; August 15, on *Croton*, many females; September 25, ex flowers of mango, one male, three females.

### **Haplothrips victoriensis** Bagnall

1918—Bagnall: Brief Descriptions of New Thysanoptera IX; Ann. Mag. Nat. Hist., [9] 1: 208.

1921—Karny: Ergaenzung zu Priesner's "Haplothripen Studien"; Die Australischen Haplothripen; Treubia, 2 [1]: 23 (fig. on p. 27).

1934—Kelly and Mayne: Monograph of the Order Thysanoptera in Australia: 44.

Has been collected from a long list of hosts in Victoria and from "flowers" on Mt. Tambourine, Queensland. Collected by Dr. Williams as follows: Noumea or near it, July 11, on rose flower, one male; August, flowering *Jasminum*, many males and females; Yahoue Valley, August 29, by beating, many males and females; Oua Tom, September 20, on *Melaleuca* flower, many males and females; Hienghene, October 5, *Chenopodium*, few males and females.

### **Haplothrips victoriensis** var. nov. **nepouiensis**

Differs from the typical *victoriensis* only in having four to six, instead of ten to 12, accessory hairs on fore wings, and in not having a sense cone on the inner side of the third antennal segment.

One male and two females collected by Dr. Williams at Nepoui in the spindle of a wild grass resembling *Saccharum*, August.

### Genus **Podothrips** Hood

Hood, Two New Thysanoptera from Puerto Rico; Insecutor Inscitiae Menstruus, 1 [6]: 67, 1913.

### **Podothrips xanthopus** Hood

1919—Hood: Proc. Biol. Soc. Wash., 32: 82.

1934—Kelly and Mayne: Monograph of the Order Thysanoptera in Australia: 49.

Described from a single female collected by sweeping in Nelson, North Queensland.

Five females collected by Dr. Williams on flowers of *Lantana sellowiana* Link & Otto at Noumea, September 6.

Subfamily Megathripinae Priesner, 1927

Tribe Compothripini Priesner, 1927

Genus *Dichaetothrips* Hood

Hood, Studies in Tubuliferous Thysanoptera; Proc. Biol. Soc. Wash., 27: 164, 1914.

*Dichaetothrips adventor* sp. nov. (pl. XIII, fig. B)

Female holotype (macropterous):—Color by transmitted light dark reddish brown; abdominal segments 7 to 9 and tube darker, almost black; all tarsi, fore tibiae, all of antennal segment 3 and distal portion of 2 sometimes—but not always—lighter, tending to yellowish brown. Eyes orange, ocellar crescents and hypodermal pigment red. Wings weakly washed with yellow; fore wing more darkly maculated anteriorly on about basal quarter, the macula gradually narrowing toward middle of wing; hind wing maculated on anterior half near base, narrowly along anterior margin for about a third of the wing length and also narrowly along median line for more than half the wing length.

Head little more than 1.5 as long as wide; very slightly widened to about half, thence weakly, evenly narrowed to slight constriction just cephalad of thickened, collar-like basal suture which is likely to be obscured by overlapping connective membrane; vertex roundly declivous, not at all produced. Eyes small, occupying about one-quarter head length; finely faceted, with about ten facets on outer outline; slightly protruding anteriorly on inner angle, not at all on sides. Ocelli larger than eye facets; the anterior one forwardly directed on the declivous vertex, just back of a tangent drawn from eye to eye; the posterior pair practically touching inner margins of eyes at about their middle. Postocellar setae about equal to eye length; placed about one ocellar diameter back of each ocellus and in line with its inner margin. Postoculars at least twice the length of an eye; placed pronouncedly outward of inner corner of eye and a little over one ocellar diameter caudad of it. Anteoocellar and other setae on dorsum and cheeks minute. Striation transverse and rather faint on most of dorsum; a few more pronounced reticula near the inner hind angle of each eye.

Antennae shaped as illustrated; sensory cones ending in a point but rather thick for their length, which is about a quarter that of segment 3; segment 3 with two cones, one ventral and one on outer side; 4 with four; 5 with three, two on outer side, one on inner side; 6 with two small cones dorsally; 7 with one small cone dorsally; 1, 2, 8 with none, but 2 with usual porus dorsally.

Prothorax a little less than one-half as long as head, about 1.6 as wide as head along hind margin (exclusive of coxae); front margin weakly concave and hind margin broadly convex; sides diverging strongly to about middle, thence weakly to hind angles, emarginate at anterior angle of epimera; median pronotal suture not reaching either the anterior or posterior margins; striation consisting of rather wide, pale colored lines, transverse narrowly along fore and hind margin, reticulate on both sides of disk, very weak on either side of median suture. Epimeral setae dark brown, straight, less than  $\frac{1}{2}$  as long as prothorax; postero-angulars, translucent, almost colorless, relatively thin, about 1.3 the length of prothorax, their point of insertion removed from hind margin by little less than one-fourth the length of prothorax. Mid-laterals, antero-angulars, antero-marginals, small and thick; postero-marginals minute.

Pterothorax almost square, almost as wide as prothorax including fore-coxae. Mesoscutum with transversely reticulate striation; with two prominent pori widely separated and ahead of the transverse median line; with another, more approximate pair of pori behind the transverse median line;

with four minute to small setae on each side along the hind margin, the median pair of these the longest. Metascutum reticulate; a series of three weak spines progressively longer from the outer to the inner one at each anterior angle; another pair approximate to the meson and twice their own length caudad of the fore margin.

Legs normal, with many scattered short, stiff setae on femora and tibiae; the tibiae outwardly near end with at least one thin, pale hair much longer than the others; fore tarsi with a very small, broad, recurved tooth inwardly at the apex of the basal segment.

Wings well developed; with 19-24 accessory ciliae; with sub-basals concolorous with wing, evenly spaced on a straight line, the proximal one half as long as the other two, which are sub-equal.

Abdomen when not distended, elliptical, widest at segment 5; with the usual setae very long, light brown; the laterals on segments 5 to 9 equal or nearly so. Tube relatively slender, more than twice as wide at base as at end, tapering evenly to about last eighth then more abruptly to end; terminal setae a little shorter than tube, shorter than laterals on segment 9.

Measurements of female holotype in mm. (paratype in parentheses): Body length 4.00; head length .395 (.379); head width across cheeks .252 (.252); length of prothorax .173 (.158); width of prothorax .395 (.379); length of tube .395 (.379); width of tube at base .126 (.126); width of tube at end .055 (.055); dorsal length of eye .096; distance from base of postocular setae to eye .032; postocular setae .237 (.237); postocellar setae .096 (.096); epimeral setae .080 (.080); posteroangulars .252 (.252); longest setae of segment 9 (laterals) .442 (.442); terminal setae of tube .316 (.316).

Antennal segments:	1	2	3	4	5	6	7	8	Total length
Type .....			.112	.102	.089	.073	.044	.051	.....
Paratype .....	.064	.076	.112	.102	.086	.070	.044	.048	.602

The male unknown. Described from two females, one on croton leaves, the other (holotype) on sugar cane leaves; Noumea, August 15 and August 22, respectively.

It is to be noted that while my two specimens agree closely in every other respect, one of them, perhaps a teneral individual, has the tarsi, fore tibiae, and third antennal segment distinctly lighter in color than the rest of the body.

This species is clearly distinguished from all others of its genus by the peculiar chaetotaxy of the prothorax. I know of no other species in which the epimeral seta is thornlike, stiff, relatively short, and dark, while the seta usually considered as "paired" with it is hairlike, pale, and exceptionally long. The size, shape, and position of the fore tarsal tooth are also noteworthy.

Suborder Terebrantia Haliday, 1836

Superfamily Aeolothripodea Hood, 1915

Family Aeolothripidae Uzel, 1895

Subfamily Aeolothripinae Bagnall, 1913

Genus *Aeolothrips* Haliday

Haliday, Ent. Mag. 3 [5]: 451, 1836.

Priesner, Die Thysanopteren Europas: 97, 1926.

**Aeolothrips inauditus** sp. nov. (pl. XIII, fig. A)

Female (macropterous):—Body length 1.9 mm. Color by transmitted light yellow-brown except distal third of antennal segment 2, basal two-thirds of antennal segment 3, and basal one-third of hind tibiae, which are white, lightly tinged with yellow. Eyes black; ocellar crescents and hypodermal pigment red.

Head little wider than long, widest across cheeks which arch gently and are constricted just back of eyes; space between eyes wide, weakly arcuate; slightly forward of hind margin and parallel to it, a thin dark line which marks the edge of a slight collar-like thickening; occiput transversely striate; occiput and vertex with many short setae, a more or less longitudinal series of three or four meso-caudal of each posterior ocellus slightly longer and thicker than the others. Eyes occupying little more than a quarter of head length, weakly protruding at inner angle in front; their ventral portion narrowed and produced caudally, their facets smaller and of more uniform size on their dorsal than their ventral portions, in both cases well separated from each other and with minute thorns between them. Ocelli larger than facets, well apart; the front one forwardly directed on the declivous vertex of head; the hind ones approximate to the eyes, clearly forward of their hind margins. Mouth cone constricted below middle and thence almost tubular to end, which reaches or barely surpasses the hind margin of prosternum; maxillary palpi very large, three-segmented, the distal segment small in comparison to the others; labial palpi long and strong, outwardly arched, four-segmented, the basal segment very short but broader than second.

Antennae not quite three times as long as head, quite slender, approximate at base; segment 3 longest, its pedicel with a distinct ringlike thickening; segments 5 to 9 progressively shorter and narrower, broadly joined into a club; segments 1, 2, and 3 at base conspicuously transversely striate with striae which under high magnification are seen to be produced into closely set microtrichia; all segments with several whorls of short, stiff, light colored hairs; segment 3 with a thin, apparently nodulose sense area which is more or less transverse dorsally near tip of segment and runs down the outer side to nearly the base; segment 4 with a similar long sense area whose transverse portion lies on the ventral surface of the segment; segments 5 and 6 with an elongate elliptical sense area, not nodulose, ventrally on the upper half of the segment.

Pronotum a little shorter than head and very slightly wider on hind margin; with numerous very small stiff setae on disk and sides; with a conspicuous dark band across whole width near posterior margin. Pterothorax normal; widest in middle, arched sides thence converging weakly towards posterior margin. Legs rather long and thin, with numerous short spines; conspicuously striate, like antennae, with thin dark lines which are produced into microtrichia visible only under high magnification; fore femora relatively short and thick, fore tarsi armed with the usual recurved hook.

Fore wings rounded at ends; reaching to about 7th abdominal segment; about seven times as long as wide in middle; their inner edge almost straight and their outer edge curved gently inward on basal fourth, so that distal three-quarters of wing are slightly wider than basal one-quarter, distal fifth and basal fourth pale yellow to colorless except at extreme base and on ring vein which, like the remaining portion of the wing, are brown or shaded with brown. Front vein connected with ring vein by two cross veins, the first about one-third, the second about two-thirds of the wing's length from its base; front and hind vein connected by one cross vein somewhat distad of the first cross vein mentioned above; hind vein and ring vein connected by two faint cross veins nearly opposite to the first two mentioned above. Scale entirely light brown, with a series of about 11 setae on anterior margin, one discal

seta near base, and two long, colorless hairs paired ventrally near tip. Hind vein entirely colorless, with long brown fringe.

Abdomen normal to genus, narrow at base, widest at segment 6, abruptly narrowed thence to base of 9 which is nearly twice the length of any other segment and narrower at posterior than anterior margin. Setae on segments 9 and 10 long and strong; others small.

Measurements of female (holotype) in mm.: Length of body 1.97; length of head .162; width of head across cheeks .192; length of pronotum .153; width of pronotum .205; length of pterothorax .395; width of pterothorax .334; width of sixth abdominal segment (distended) .547.

Antennal segments:	1	2	3	4	5	6	7	8	9	Total
Length .....	.042	.061	.128	.067	.055	.039	.027	.015	.012	.446
Width .....	.042	.030	.027	.030	.027	.024	.018	.012	.006	

Male (macropterous): Smaller than female; about 1.44 mm. long. Colored like female but paler (particularly at tibiae) and with a great abundance of hypodermal pigment showing through on abdomen and thorax. Abdomen widening only moderately from base to segment 3, thence very gradually narrowing to end. Setae on segments 9 and 10 long, those on sides of 9 the longest; other abdominal setae short and weak. No claspers on hind angles of 9.

Measurements of male in mm.: Length of body 1.44; length of head .162; width of head .174; length of pronotum .153; width of pronotum .186; length of pterothorax .319; width of pterothorax .273; width of third abdominal segment .197.

Described from the following material, which does not include all of Dr. Williams' collections:

Yahoue Valley, September 29, by beating, 2 ♀ and 1 ♂; Oua Tom (holotype and allotype), September 20, flowers of *Melaleuca*, 1 ♀ and 1 ♂; hills back of Noumea, September 24, flowering tree, 1 ♀; Noumea, September 25, mango flowers, 1 ♀.

I cannot find in the literature any other species which combines, like the present one, the typical shape of *Aeolothrips*, the single banded fore wings, and the four cross veins, with the apparently nodulose sense areas of *Franklinothrips*. This unusual combination suggested the name *inauditus*.

Superfamily Thripodea Hood, 1915

Family Thripidae Uzel, 1895

Subfamily Heliothripinae Karny, 1921

Genus *Heliothrips* Haliday

Haliday, Ent. Mag., 3 [5]: 443, 1836.

Karny, s. str., Entomologische Rundschau, 28: 179-182, 1911.

Karny, Treubia, 1 [4]: 239, 1921.

Priesner, Die Thysanopteren Europas: 125, 1926.

*Heliothrips rubrocinctus* (Giard)

1901—*Physopus rubrocincta* Giard; Bull. Soc. Ent. France: 263.

1908—*Heliothrips rubrocinctus* (Giard); Franklin: Proc. U. S. Nat. Mus., 33: 719.

1911—*Heliothrips (Selenothrips) rubrocinctus* (Giard); Karny: Entomologische Rundschau, 28 Jahrgang: 179.

1912—*Heliothrips rubrocinctus* (Giard); Russell: U.S.D.A. Ent. Bul. 99[2]: 17-29.

1928—*Selenothrips rubrocinctus* (Giard); Moulton: Thys. of the Hawaiian Islands; Proc. Haw. Ent. Soc., 7: 116.

Known from southern United States, West Indies, Uganda, Mauritius, Ceylon, Hawaii. Three females collected by Dr. Williams at or near Noumea, without host or date record.

#### Subfamily Chirothripinae Karny, 1921

##### Genus *Chirothrips* Haliday

Haliday, 1836, Ent. Mag., 3: 444.

Priesner, 1926, Die Thysanopteren Europas, 136.

##### *Chirothrips aculeatus* Bagnall

1926—*Chirothrips similis* (nec Bagnall) Priesner; Die Thysanopteren Europas, 142.

1927—*Chirothrips aculeatus* Bagnall; Ann. Mag. Nat. Hist., [9] 19: 567.

1939—*Chirothrips aculeatus* Bagnall; Floyd André: A Synopsis of the American Species of Chirothrips; Proc. Ent. Soc. Wash., 41 [6]: 196.

Recorded from England, continental Europe, western United States and Australia.

Collected by Dr. Williams in or near Noumea, as follows: August 23, in spindle of sugar cane, five females; September 6, in flowers of *Lantana sellowiana* Link & Otto, four females; September 27, in spindle of sugar cane, one female; no date, Johnson grass, nine females; numerous males and females in July, without further data.

#### Subfamily Sericothripinae Karny, 1921

##### Tribe Sericothripini Priesner, 1926

##### Genus *Scirtothrips* Shull

Shull, Ent. News, 20 [5]: 222, 1909.

Hood, Proc. Ent. Soc. Wash., 16 [1]: 40, 1914.

Karny, Treubia, 1 [4]: 237, 240, 1921.

Priesner, Die Thysanopteren Europas: 169, 1926.

Moulton, Rev. de Ent., 3 [1]: 102, 1933.

##### *Scirtothrips albomaculatus* sp. nov. (pl. XV, figs. A, B, C)

Female (macropterous): Body length .80 mm. Color by transmitted light orange-yellow clouded with brown; the sides of abdominal tergites 2 to 8 with irregular white areas; median area of 8 and all of 9 and 10 evenly light

greyish yellow; 3 to 8 with a narrow dark band on median two-thirds near fore margin; legs lighter than body, with tibiae lighter than femora; fore wing and scale uniformly yellowish brown; hind wing almost colorless, with cloud on basal fifth, with vein brown along most of its length; eyes purplish, nearly black (by reflected light, dark blood red); ocellar crescents red. Antennal segment 1 clear lemon-yellow, 2 light orange-yellow, others yellowish brown. Striation of thin, dark, closely set, transverse lines, conspicuous on back of head, pronotum, fore part of mesonotum, and legs, but not apparent elsewhere.

Head twice as wide as long, widest across eyes; the cheeks arching weakly and converging caudally; front roundly depressed next to the eyes and roundly bulging in the middle, slightly overhanging the antennal bases, which are separated by about the width of basal segment. Eyes large, occupying two-thirds of head length; their facets prominent, relatively large and with coarse, short spines between them. Ocelli about size of facets, close together, far removed from inner margin of eyes; anterior one forwardly directed just ahead of transverse median line across eyes; posterior pair slightly forward of hind margin of eyes. Two minute setae on the ocellar triangle back of the anterior ocellus; a similar seta back of each posterior ocellus and two or three others back of each eye; four longer setae on the front, the median pair forward of the other two which are near to the eye. Antennae more than twice as long as head; segments of shape illustrated; segments 3 and 4 with forked sense cones dorsally and ventrally respectively; 5 with short sense cone outwardly near tip; 6 with single cone inwardly near middle, long, sharp, closely pressed to segment. Forked sense cones rather long and thin, set on about distal third of segment on a transverse shelf caused by the sudden excavation of the segment's surface. Longer hairs concolorous with antennae, rather long and thick, set on the same plane as the forked sense cones; a particularly conspicuous, strongly curved hair on inner surface of segment 2 about middle.

Prothorax somewhat longer and wider than head, widest just ahead of hind margin, its angles almost square, its sides weakly arched; six to eight minute setae on fore margin; about 16 more or less symmetrically dispersed on dorsum and sides; a series of eight on hind margin, six minute and the next to the innermost pair long and strong, about .028 mm. long.

Pterothorax normal; mesothorax much wider than metathorax; all four spines on metascutum inserted near margin, the median spines farther apart from each other than from lateral spines. Fore wings uniformly brown, with usual longitudinal rows of closely set microtrichia; narrowing at basal fourth; with long fringe not wavy on either fore or hind margin. Veins invisible, except fore vein near base; costa with 29 evenly spaced spines; fore vein with 11 in two series of three and eight respectively, plus two widely separated nearer the end; hind vein with a series of five or six distad from middle of wing and one nearer tip of wing; all spines thick, brown. Hind wing pale except at base; its vein conspicuous brown except near base and apex. Wing scale narrow and long, with four strong spines on fore margin, one thinner spine basally on disk, two long transparent hairs paired ventrally near tip. Legs normal, paler than body, abundantly setose but without long hairs.

Abdomen widening gradually to segment 6, thence narrowing more suddenly to end of 10, which is blunt; six intermarginal spines on tergites 2 to 8 the outermost of these approximately of the same size on all segments, the others increasingly strong towards caudal segments; the median pair approximate on first segments, increasingly farther apart towards caudal segments. Tergites 1 to 7 closely and distinctly pubescent on lateral third, with pubescence extending caudally beyond margin as rather long sparse, evenly spaced fringe; tergite 8 pubescent and fringed on whole width; tergites 9 and 10 pubescent on whole width but not fringed. Tergite 9 with the longest

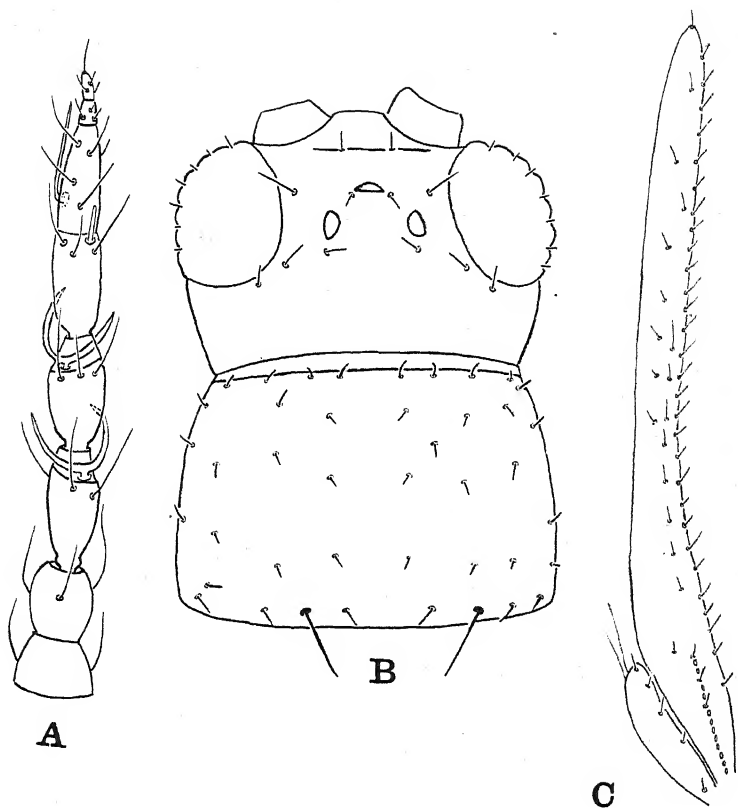


PLATE XV

*Scirtothrips albomaculatus* sp.n.

A—Right antenna of female, dorsal view.

B—Head and prothorax of female.

C—Left fore wing and wing scale of female, with long fringe hairs omitted.



setae of body on hind angles and four others almost as strong and long on the disk, two close to each other and just caudad of the transverse median line, the other two apart from each other and cephalad of the transverse median; in addition a colorless, inconspicuous seta near hind margin, inward of each hind angle. Tergite 10 with two dark median setae on hind margin not much longer than segment; other setae on sides and sternite of segment pale and weak.

Measurements of female (holotype) in mm.: Length of body .80; length of head .070; width of head .140; length of prothorax .091; width of prothorax .146; length of longest spine on posterior margin of prothorax .028; length of spines on hind angles of segment 9, .061.

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.015	.027	.042	.039	.033	.042	.007	.010	.215

Described from one female collected on a rose flower at Noumea, July 11. The male is unknown.

This species seems to be closely related to *Scirtothrips longipennis* (Bagnall), 1909, and in Priesner's key to the genus runs to that species; but it can be distinguished at once by the chaetotaxy of the wings, and the peculiar white areas on the sides of the abdominal segments.

### **Ensiferothrips gen. nov.**

Head short and wide. Eyes strongly protruding; ocelli present and born on humped vertex. Antennae apparently nine-segmented, with forked trichomes on segments 3 and 4. Mouth cone constricted in distal portion and about as long as prothorax; maxillary palpi two-segmented and labial palpi one-segmented. Striation of head, pronotum, sides of abdominal segments and some other parts of the body reticulate or nearly so. Most of dorsal surface of body and wings thickly beset with short thornlike microtrichia; not so the median third of abdominal segments 2 to 8. Setae of head, thorax, and wings enormously dilated, flattened, the larger ones sword-shaped, the smaller ones usually strongly curved. Legs normal, slender. Wings long, broad at base, gradually reduced to pointed tip; veins not apparent but a series of flat, dilated setae indicating their position.

This new genus is clearly allied to *Scirtothrips*, agreeing with that genus in general features and with Karny's subgenus *Proscirtothrips* in having apparently nine-segmented antennae. It is at once distinguished from all its allies, however, by the clearly reticulate striation and the uniquely flattened and dilated setae of the head, wings, and thorax, whose shape has suggested the generic name: sword-bearing thrips. The genotype is *Ensiferothrips primus* sp. nov., described below.

### **Ensiferothrips primus sp. nov. (pl. XVI, figs. A, B, C)**

Female (macropterous): Length .68 mm. General color by transmitted light, dark brown with red hypodermal pigment showing through abundantly on head, prothorax and sides of abdominal segments. Eyes black; ocellar crescents red; median third of abdominal segments 2 to 8 much lighter than sides; tips of tibiae and all first tarsal segments pale. Antennal segments 1 and 2 dark brown, concolorous with head; 3, 4 and basal half of 5 pale; the rest of the antennae uniformly light greyish brown. Fore wings with

basal three-fourteenths white, the following six-fourteenths brown, the following two-fourteenths white, the following two-fourteenths brown, and the distal one-fourteenth white; limits between white and brown areas not sharp, wing setae white or brown, corresponding in general to the area of insertion. Hind wings colorless except along all but extreme end of vein, which is dark brown.

Head nearly three times as wide as long; cheeks strongly convergent caudally; vertex elevated into a broad hump and slightly produced frontally, excavate laterally next to eyes; ocelli borne on the hump, the front one anteriorly directed, the others dorso-laterally; eyes large, coarsely faceted, sparsely pilose, strongly protruding frontally and laterally, their dorsal outline round and occupying two-thirds of head length, their ventral outline produced caudally and forming a wide angle; interocellar setae almost as long as diameter of eye, shaped like a wide sword blade, their bases tuberculiform, inserted within ocellar triangle just ahead of each posterior ocellus; two small, dilated, inwardly curved setae approximate and laterad of the anterior ocellus; a similar somewhat smaller seta between each of the former and the margin of the eye; a considerably stronger curved seta on the cheek back of each eye. Mouth cone rather broad; reaching or slightly surpassing the posterior margin of the prothorax; constricted somewhat below the middle and blunt at the end. Maxillary palpi long and slender, two-segmented; first segment slightly dilated distally, longer and wider than 2nd. Labial palpi one-segmented, small, uniformly cylindrical.

Antennae about four times as long as head; inserted caudo-ventrad of vertex and separated at their bases by about the width of segment 1. Segments 3 to 5 pedicellate; 5 and 6 broadly joined; 6 with a complete circular division at about its apical fourth, causing the style to seem three-segmented, the apical segment somewhat longer than either of the other two. Segment 2 with conspicuous, the others with inconspicuous, transverse striae produced into closely set microtrichia which are light or dark colored, according to the segment bearing them; segment 2 with a small circular sense area dorsally near end; segments 3 and 4 with small forked sense cones, respectively dorsal and ventral; a sense cone outwardly on segment 6 thin, translucent and hardly distinguishable from longer hairs; all hairs weak and translucent except a whorl of long, brown, curved setae on segment 2 and one short, curved, distended seta on inner side near tip of segment 1.

Pronotum somewhat less than twice as long as head, slightly wider than head at hind margin; front and hind margins straight; sides slightly arched; surface strongly convex and conspicuously reticulate except at hind angles; ten small, curved, distended setae distributed more or less symmetrically on dorsum and sides; a series of six dark, stout, sword-shaped setae along hind margin, the outermost pair on the hind angles, each seta of the median pair with a minute curved one laterad and approximate to it, all these setae with prominent tuberculiform bases.

Pterothorax longer on sides than combined median lengths of head and pronotum and conspicuously wider than hind margin of pronotum, widest across mesonotum and metanotum and round at hind angles; mesoscutum transversely striate with short, curved lines which tend to form a transversely reticulate pattern; metascutum longitudinally reticulate; other striation of pterothorax also generally reticulate or nearly so. All small setae on sides and notum pale and inconspicuous but under magnification appearing to be sword-shaped and with prominent bases. Metascutum without large setae but with two conspicuous pori paired medianly and distinctly removed from front margin.

Legs normal in structure but hind legs unusually long and thin with both femora and tibiae cylindrical; tarsi two-segmented, the first segment, particularly on hind legs, much longer than second; femora and tibiae with dark,

semi-reticulate striation and beset with many moderately long spines of normal straight shape.

Wings long, reaching to end of body, with many closely set rows of microtrichia. Fore wings wide basally and narrowed rather sharply at basal fourth, whence they narrow gradually to rather pointed end; the costal margin beset with about 30 setae which are stout, evenly spaced, invariably curved towards end of wing and set in prominent bases; the fore and hind veins not distinguishable, but their position marked by series of enormously distended, relatively short, sword-shaped setae inserted on prominent bases, about eight on fore vein with four of them approximate on basal fourth of wing, four at wide intervals on hind vein; fringe on hind margin of wing long, straight, evenly and closely set. Hind wing narrow, with the second one-eighth wider than rest of wing; with fringe on both margins commencing at about basal fourth; fringe on fore margin sparse and shorter than on hind margin; vein dark brown almost to tip of wing.

Abdomen rather broad and when not distended just about as long as head and thorax together; widening abruptly at segment 2 which at hind margin is about equal to 3, 4, and 5, thence narrowing evenly from segment 6 to end of 10 which is blunt. Lateral thirds of segments 2 to 8 reticulately striate and densely beset with short, thorn-like microtrichia which appear as minute dark dots and cause the abdomen to appear paler medianly from segment 2 to 8; segment 1 reticulately striate and beset with microtrichia across its whole width; segments 9 and 10 beset with rather long, thin pubescence and without apparent striation; hind margin of segment 8 with a complete evenly spaced and rather long fringe; hind margins of 7 and 6 with a similar but sparser fringe medianly; segment 1 with a pair of median pori; segments 2 to 8 with a pair of long median setae of normal structure and others, shorter and thicker, on the sides; segment 9 with four strong setae dorsally near posterior margin and segment 10 with two, all of these setae of normal shape, sharply pointed and about as long as segment 10.

Measurements of female (holotype) in mm.: Length of body .68; length of head .045; width of head (across eyes) .131; length of pronotum .073; width of pronotum (hind margin) .143; length of pterothorax .177; width of pterothorax .201; width of abdomen (3rd segment) .243; length of interocellar setae (approx.) .033; length of pronotal setae (approx.) .042.

Described from two females collected on a flowering tree; hills back of Noumea, September 24, 1940. The male is unknown.

#### Tribe Anaphothripini Priesner, 1926

#### Genus *Anaphothrips* Uzel

Uzel, Monographie der Ordnung Thysanoptera: 142, 1895.

Karny, Treubia, 1 [4]: 242, 1921.

Priesner, Die Thysanopteren Europas: 181, 1926.

Moulton, Rev. de Ent., 3 [1]: 107, 1933.

#### *Anaphothrips speciosus* Hood

1919—Hood, Proc. Biol. Soc. Wash., 32: 76.

1934—Kelly and Mayne, Monograph of the Order Thysanoptera in Australia: 22.

Described from one female taken by sweeping grass at Brooklyn, N. S. W.

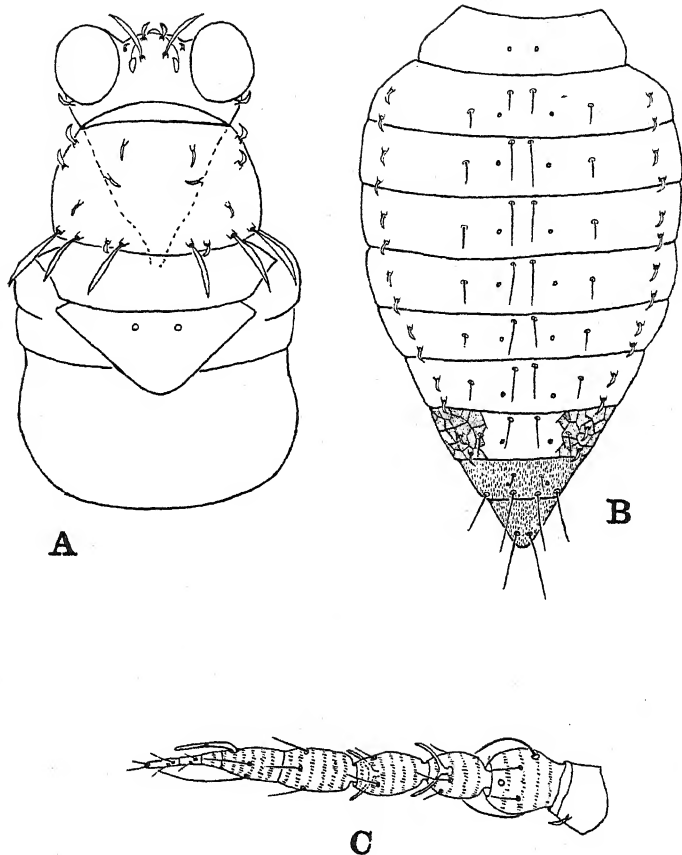


PLATE XVI

*Ensiferothrips primus* sp.n.

- A—Head and thorax of female. Setae of pterothorax omitted.  
 B—Dorsal view of abdomen of female; with lateral sculpture of segments 2 to 8 shown only on segment 8.  
 C—Right antenna of female, dorsal view.

Found by Dr. Williams in Noumea, September 27, in the spindle of sugar cane, and in Nepoui, August, in the spindle of a wild grass resembling *Saccharum*.

**Anaphothrips swezeyi** Moulton

1927—Proc. Haw. Ent. Soc., 7 [1]: 107.

Known heretofore only from Hawaii, where it is fairly common.

Five females collected by Dr. Williams at Noumea, September 27, in the spindle of sugar cane; one female in the same manner and locality on August 23; one female "on sugar cane" at Nepoui, in August.

Sugar cane is apparently one of the common hosts of this thrips in New Caledonia, which makes it seem strange that the species has not been recorded on that host in Hawaii.

Subfamily Thripinae Karny, 1921

Genus **Taeniothrips** Amyot and Serville

Amyot and Serville, Insectes Hemipteres (Roret's Suite a Buffon): 644, 1843.

Priesner, Die Thysanopteren Europas: 269, 1926.

Moulton, The Thysanoptera of South America; Rev. de Ent., 3 [1]: 129, 1933.

**Taeniothrips kellyanus** (Bagnall)

1916—*Physothrips kellyanus* Bagnall; Ann. Mag. Nat. Hist., [8] 17: 219.

1926—*Physothrips kellyanus* Bagnall; Ann. Mag. Nat. Hist., [9] 18: 104.

1933—*Taeniothrips kellyanus* (Bagnall); Steinweden, Key to All Known Species of the Genus *Taeniothrips*; Trans. Am. Ent. Soc., 59: 280.

1934—*Physothrips kellyanus* Bagnall; Kelly and Mayne, Monograph of the Order Thysanoptera in Australia: 25.

Known from many hosts in Queensland and Victoria. Found by Dr. Williams as follows: Noumea, July, two females; Noumea, September 6, six females on *Vitex negundo* Linn.; Hienghene, October 1940, several males and females on *Cerbera* flowers.

**Taeniothrips novocaledonensis** sp. nov. (pl. XIV, fig. D)

Female (macropterous): Length about 1.2 mm. Color by transmitted light brown with yellow tinge. Fore tibia (sometimes also middle tibiae), all tarsi, third antennal segment pale yellow with brownish tinge. Fore wings suffused with brown except on basal fourth which is clear except for irregular brown blotches near extreme base and on scale. Eyes purplish black; ocellar crescents red; hypodermal pigmentation red to orange, sometimes absent. Dark narrow band across abdominal segments 3 to 8 near fore margin. Transverse cuticular striations particularly noticeable on dorsum of head, dorsum of thorax, sides of abdominal segments. On metanotum transverse striation in

front and oblique striations on sides form a triangular pattern surrounding the disk, which is subreticulate.

Head considerably wider than long, widest across cheeks; constricted at base of eyes, cheeks thence arching to base of head; space between eyes straight and wide in front. Eyes not protruding, occupying about half the length of the head, coarsely faceted, sparsely pilose. Ocelli larger than facets of eyes, distance between posterior ones longer than between them and anterior ocellus; anterior ocellus forwardly directed, on the transverse line across middle of eyes; posterior ocelli cephalad of posterior margin of eyes and not touching their inner margin; two small setae slightly cephalad of anterior ocellus on each side; a postocellar seta only slightly shorter than interocellars just back of each posterior ocellus, and a series of four or five smaller setae arching around the hind margin of the eye. Antennae about twice as long as the head; generally concolorous with the head, except always segment 3 which is pale yellow; the segments shaped as illustrated; relative length of segments 3 to 6 subject to some variation but 5 always shorter than 3, 4, or 6, and 7 and 8 always about equal to each other; all segments except 1, 7, and 8 with evenly spaced ringlets of microtrichia and with a ring of four long hairs on the distal third of each segment; these hairs always light colored, no more than half the length of the segment bearing them, weaker and shorter on segment 6 than on the others; forked sense cones on segments 3 and 4, and a single sense cone on 6, all rather thin for their length, which is about half of segment bearing them. Mouth cone reaching slightly past middle of posternum, twice constricted, about middle and near tip, which is rounded. Labrum dark in color and sharply constricted near tip; squarely cut off at the end. Segments 1, 2, 3 of maxillary palpi respectively about .012, .008, .016 mm. long and progressively thinner.

Prothorax considerably longer than head and wider on hind margin, the sides straight in specimens not distended and diverging caudally; the sides, fore margin and disk more or less symmetrically beset with about 40 small setae of which the outermost on each side are stouter than the others; the paired setae on hind angles rather thornlike, stout at base, evenly narrowed to a sharp point; a small seta always between the pair, and a series of six (rarely eight) along the hind margin of the prothorax, with the middle two always stouter and longer than the others.

Pterothorax rounded in front, widest at its caudal third; the inner pair of metanotal setae about three-quarters the size of those on angles of prothorax, the outer pair much smaller, both pairs inserted near the anterior margin. Legs normal; tarsi without claw, with dark blotch near extreme end; all femora and tibiae clothed with many short stiff setae; only hind tibiae with a row of about eight colorless, short, stout spines on the inner edge and two stouter ones distally. Wings reaching to about segment 8, of normal shape and structure, with many longitudinal rows of microtrichia; hind fringe of both wings long, thick and wavy; front fringe shorter in both, straight in both, set at longer intervals on posterior wing than on anterior one; veins not apparent except near base of anterior wing, conspicuously tinged with brown on all but tip of posterior wing; setae on costa of fore wing 27; setae on anterior vein of fore wing usually ten, equally spaced on basal half, and three widely apart on distal half, sometimes the basal setae indistinctly divided into groups of 4-4-2 or 4-6, the outermost distal seta always about its own length from tip of wing; setae on posterior vein equally spaced and consistently 16-17; five setae along anterior margin of scale, progressively longer towards tip, one on disk of scale near base, the usual thin translucent pair inserted close together near tip ventrally.

Abdomen widens rather suddenly to segment 3, which is about equal to 4, thence narrows gradually and evenly to end of 10, which is blunt at apex and split along most of its length. Tergites 3 to 8, sometimes also 2, have a

narrow dark stripe on their whole width near the fore margin. Tergites 2 to 8 bear at extreme hind angle a long strong spine and cephalad of this a series of three smaller spines; on tergite 2 the outermost spine of the series is cephalad of the others, which are on the median transverse line; on 3 to 5 all three spines are on the median transverse; on 6 to 8 the middle spine is vestigial or absent. Equidistant from the meson and slightly cephalad of the median transverse line tergites 2 to 7 bear two very minute setae and somewhat outward from these, on the median transverse, two small pori; on tergite 8 the two spines are somewhat stronger and closer together. Tergites 5 to 8 bear near each side a more or less curved row of short microtrichia visible only in clear mounts and under high magnification. The ciliary fringe across tergite 8 is conspicuous, complete, unevenly spaced, rather long and sparse. Tergite 9 bears a row of four stout spines, equally spaced and just caudad of the median transverse; two other shorter, curved, brown spines cephalad of the median transverse line; two stiff, translucent white spines between the series of four and the hind margin of the segment. Segment 10 bears a circlet of six spines of which two on the dorsum and two on the sides are longer than the ventral pair. The epipleurites of 3 to 7 bear a progressively longer seta on the lower hind angle, and two or three spines, not progressively longer, which cannot be accurately located in dorso-ventral mounts although they protrude beyond the sides. Sternites 3 to 7 bear six long setae on the hind margin and a series of 12 or 14 intermarginal setae on or near the median transverse line. Sternite 2 bears only four marginal setae and two intermarginal ones, the latter nearer the meson than the sides.

Measurements of female (holotype) in mm.: Body length 1.24; prothorax length .13; pterothorax length .24; pterothorax width .25; abdomen width (segment 4) .27; head length .09; head width .14; eye length .05; intercellular setae .027; inner setae on hind angle of prothorax .048; outer setae on hind angle of prothorax .045; lateral setae on segment 9, .085; postero-marginal setae on segment 9, .073; terminal setae on segment 10, .094.

Antennal segments:	1	2	3	4	5	6	7	8
Type .....	.0153	.0306	.0489	.0459	.0336	.0481	.0061	.0061
Paratype .....	.013	.035	.048	.044	.030	.048	.008	.008

Male (macropterous): Length about 1.04. Color as in female except tip of antennal segment 2 and base of 4 which approximate light shade of 3. Wings as in female, with costa of fore vein bearing 24 setae, anterior vein bearing 11 basal and two distal setae. The glandular areas of abdominal sternites 3 to 7 progressively shorter and wider towards the hind segments but in general long for their width, brownish yellow in color and conspicuous against the darker sternites. Tergite 9 bears, about one-third of its length from the posterior margin, a row of six setae, the outer pair minute and approximate to the hind angles, the middle and inner pairs about half as long as the segment and approximate to the meson, the middle pair curving inwards, the inner pair straight and stiff; on the transverse median a pair of small setae outward from the middle pair mentioned above and a pair of pori inward from the same; another porus distad and inward of each anterior angle; the hind margin roundly emarginate in the middle and the chitin at each posterior angle produced backward and slightly upward in the form of a strong, blunt tooth shaded darker than the rest of the segment.

Measurements of male (allotype) in mm.: Length about 1.04; length of head .104; length of prothorax .116; width of head across cheeks .131; width of prothorax .174; outer seta on hind angle of prothorax .042; inner seta on hind angle of prothorax .042.

Antennal segments:	1	2	3	4	5	6	7	8
	.021	.036	.052	.048	.033	.052	.006	.006

Described from the following material:

Noumea	July ?	unreported host	1 female
Noumea	July 11	rose flower	2 males
Noumea	Sept. 6	<i>Lantana sellowiana</i> flowers	1 male
Noumea	Sept. 25	mango flower	1 female
Noumea	Sept. 26	<i>Lantana camara</i>	1 male, 1 female
Yahoue Valley	Aug. 24	beating	1 female
La Foa	Sept. 21	nasturtium flowers	6 males, 1 female

Although the males of this species resemble the females, and that is not the case in *Taeniothrips hawaiiensis*, the two species seem to be closely related. In size, shape, and general arrangement of the spines the females of the two species are very much alike. Nevertheless they can be separated by the following differences, which in my series of both species are quite consistent, 1: In *novocaledonensis* the middle and hind tibiae and femora are almost invariably concolorous with the body, the middle tibiae only seldom partly yellow; in *hawaiiensis* the legs are always wholly and uniformly pale yellow. 2: In *novocaledonensis* the abdomen is invariably of the same quality of brown as the thorax, although the thorax is sometimes darker; in *hawaiiensis* the thorax is almost invariably darker than the abdomen and the latter is greyish brown, rather than yellowish brown as in *novocaledonensis*. 3: In *novocaledonensis* the basal spines of the fore vein are ten, seldom separated by wide spaces into groups; in *hawaiiensis* the basal spines of the fore-vein are seven to eight, almost always separated into groups of 4-3 or 4-4. 4: In *novocaledonensis* the number of setae on the posterior vein of the fore wings is consistently 16-17; in *hawaiiensis* the number varies between 11 and 15. In *novocaledonensis* the cheeks are sharply constricted just back of the eyes; in *hawaiiensis* this constriction is only seldom apparent.

#### Genus *Isochaetothrips* Moulton

Moulton, Thysanoptera from Abyssinia; Ann. Mag. Nat. Hist., [10] 2: 227, 1928.

Moulton, The Thysanoptera of South America; Rev. de Ent., 3: [1]: 127, 1933.

#### *Isochaetothrips seticollis* (Bagnall)

1915—*Taeniothrips seticollis* Bagnall; Ann. Mag. Nat. Hist., [8] 15: 591.

1928—*Isochaetothrips seticollis* (Bagnall); Moulton, Thysanoptera from Abyssinia; Ann. Mag. Nat. Hist., [10] 2: 227.

1934—*Physothrips seticollis* (Bagnall); Kelly and Mayne, Monograph of the Order Thysanoptera in Australia: 24.

Described from a single female collected on *Acacia* flowers in Mundaring Weir, West Australia. There is no record of its im-



portance in Australia, but this is obviously a common species in New Caledonia. The following records of Dr. Williams' collection include only representative material which I have mounted; there are a number of additional specimens in alcohol: "Hills back of Noumea", August, flowering *Jasminum*, a few males and females; Noumea, August 15, on *Croton*, one female; Noumea, September 6, on *Acacia laurifolia* Willd. (maritime), one female; Noumea, September 6, flowers of *Lantana sellowiana* Link & Otto, one female; Hienghene, October 5, on *Cerbera* flowers, one female; Duthio near Thio, October 8, on Myrtaceae, seven females; Oua Tom, September 20, on flowers of *Melaleuca*, two females.

***Isochaetothrips insignis* sp. nov.**

Color by transmitted light lemon-yellow to orange-yellow clouded with brown, prothorax and pterothorax darker; abdominal tergites 2 to 8 with more brown along middle than sides; end of segment 9 and all of 10 brown; a narrow brown band on anterior margin of tergites 2 to 9 with a very thin dark line caudad of this and a similar line cephalad of posterior margin; wings yellowish brown, light and uniform; legs concolorous with body, femora sometimes a little darker; eyes black by transmitted light, red by direct light; ocellar crescents red, hypodermal pigment orange-yellow to red.

Head wider than long, widest across cheeks which are strongly arched; dorsum finely striate transversely; front broadly, shallowly concave between eyes; eyes occupying little less than half the head length, seven or eight facets on their outer margin, rather coarsely and sparsely pilose; ocelli larger than eye facets, close together, far back, the anterior one behind the middle of eyes, the posterior pair almost in line with hind margin of eyes, close to but not touching, their inner margin; a small seta approximate to inner margin of each eye and considerably forward of anterior ocellus; two minute setae—difficult to make out—on the ocellar triangle, immediately caudad of anterior ocellus; postocellar setae about as long as ocellar diameter and just back of posterior ocelli; one or two similar setae laterad and approximate to postocellars, and one or two sometimes stronger setae back of each eye and near outer margin of head. Mouth cone not quite reaching anterior margin of mesothorax, abruptly constricted below middle, thence weakly tapering to end. Antennae of structure normal to genus, characterized by the invariably equal length of segments 3 and 4 and by the rich orange-yellow color of segment 2, contrasting always conspicuously with 1 which is almost colorless and with 3 to 8 which are uniformly brown. Antennal hairs about half length of longest segment, pale, weak, relatively longer and stronger on segment 2. The usual sense cones rather long and thick, colorless, sharp at the end.

Pronotum about half again as long as head, about a fourth again as wide, widest in the middle, its sides arched, its hind angles rounded, with about 40 short, light brown spines scattered over disk and sides, with a row of six somewhat thicker spines along hind margin, with a pair of strong, stiff setae of equal length at each hind angle and a short spine between each pair. Pterothorax normal to genus; the usual setae of mesoscutum and metascutum all lighter, shorter, weaker than those on hind angles of pronotum, the inner pair on metascutum caudad more than their own length from fore margin and about their own length from each other, the outer pair on the fore margin. Legs normal, clothed with many short, pale, stiff hairs; the hind tibiae with the usual series of seven or eight spines along inner edge and the three or four stronger distal ones; all tarsi with the usual dark blotch near tip. Wings washed uniformly with pale yellowish brown; veins not visible except upper vein of fore wing basally and vein of hind wing which is light brown along

most of its length; all setae light brown, translucent, 28 to 34 on costa, 16 to 19 on lower vein, 26 to 30 on upper vein, with the four basal ones always in a series separated from the others by a space. Wing scale with a series of four setae distally and one seta basally on fore margin and one seta basally on disk; with the usual long, translucent, paired hairs ventrally near tip.

Abdomen normal, widening gradually to segment 5, thence narrowing more abruptly to 8 and still more abruptly thence to end; segment 10 squarely truncate at end, not split above; usual setae all brown, relatively short, stiff, those on segment 9 the longest and strongest, those on 10 finer, about length of segment bearing them; fringe on hind margin of 8 consisting of between 20 and 30 evenly spaced, rather long microtrichia, complete across middle of margin but failing to reach sides of the tergite; a similar but coarser, shorter fringe on each side of tergites 2 to 7 occupying about one-eighth of the hind margin on each side; tergites 8, 7 and 6 with a curved line of closely set microtrichia more or less longitudinally near each lateral margin, each line, except under great magnification, appearing as a row of minute dots.

Measurements of female (holotype) in mm.: Length (slightly distended) 1.2; length of head .082; width of head .137; length of pronotum .131; width of pronotum .174; hairs on hind angles of pronotum .03.

Antennal segments:	1	2	3	4	5	6	7	8	Total
Holotype .....	.021	.033	.039	.039	.030	.039	.006	.009	.216
Paratype .....	.021	.030	.033	.033	.027	.036	.006	.009	.195

Described from eight females collected by beating at Yahoue Valley, August 29. The male is unknown.

The remarkable and beautiful color of this species suggested the name *insignis*. It may possibly turn out to be synonymous with *myrsiniicola* (Bagnall), which is also described as a yellow species. The description of *myrsiniicola*, however, was based on a single male and until the males of *insignis* are collected and correctly associated with their females it will not be possible to establish the synonymy of the two species, if it is a fact.

### Genus *Diarthrothrips* Williams

Williams, A new Thrips Damaging Coffee in British East Africa; Bul. Ent. Res., 6: 269, 1915.

### *Diarthrothrips saccharicolus* sp. nov. (pl. XIV, figs. B, C)

Female (macropterous): Length about 1.2 mm. (1.5 mm. when completely distended). Color by transmitted light pale brown to dark brown, except all tarsi, distal fourth of fore tibiae (sometimes also of the other tibiae), and antennal segments 3, 4, 5 and tip of 2 which are pale brownish yellow. Ocellar crescents and hypodermal tissue, which is scarce, red. Eyes by direct light red; by transmitted light black. Wings pale brownish yellow, almost colorless in some specimens; the vein on hind wing narrowly dark from basal third to distal fifth. Striation consisting of delicate, transverse, anastomosing lines more noticeable at base of head, base and sides of prothorax, all of abdominal tergites 1 and 9, and sides of other abdominal tergites. Mesoscutellum longitudinally reticulate.

Head a little longer than wide; sides parallel; occiput a little swollen and projecting somewhat beyond the eyes, slightly overhanging the antennal bases. Eyes large, hardly projecting, evenly rounded dorsally but ventrally their angle produced slightly backwards, the facets with sparse pilosity between them, about eight occupying the outer outline of the eye. Ocelli somewhat

larger than facets of eye, about equidistant from each other, the front one just ahead of a transverse line across the middle of the eyes, the posterior pair forward of the caudal margin of the eyes and separated from the eyes by less than one ocellar diameter. Anteo-cellular spines about three-fourths as long as width of eye, placed just out of ocellar triangle on a tangent projected laterally from the caudal margin of the front ocellus. A transverse row of four minute setae on the occiput; a similar row curving just caudad of each eye; a small seta on either side of the meson about midway between caudal margin of eyes and base of head. Mouth cone long, bent downwards; when pressed against prosternum in mounted specimens not too far distended reaching or surpassing fore margin of mesosternum, suddenly constricted at somewhat more than half its length from the base, coarsely striated near tip. Maxillary palpi, two-segmented; the distal segment longer and thinner than basal one, tapering but slightly, provided with three or four long hairs at the end. Labial palpi relatively long and thin, apparently one-segmented. Antennae as illustrated, eight-segmented, about one and five-sevenths as long as the head; pubescence sparse and weak, the longer setae always near the end of the segment, always translucent, never longer than half of longest (6th) segment; segments 3 and 4 with small, thin forked trichomes, latero-dorsad and ventrad, respectively; segment 3 also with a small single trichome outwardly and ventro-laterally, and segment 6 with a similar but longer trichome on the inner edge.

Prothorax but slightly longer than head; its sides almost straight, diverging to caudal margin, which is one-fourth wider than fore margin. Two long thin spines at each hind angle, with one minute seta between them and a series of six small setae spaced along the hind margin; a similar series of eight small setae along the fore margin and 14 dispersed more or less symmetrically on the disk and sides.

Pterothorax about as long as head and prothorax together, smoothly rounded in front, widening at sides to square hind angles; wider than prothorax at about a fourth of its length from the fore margin, about equally wide across hind margin. Legs normal, the hind pair longer, the front pair thicker than the others; hairs few, translucent, thin excepting two stout distal spines on hind tibiae and a row of four short, stout setae on the inner edge of same. Tarsi normal, two-segmented, the distal segment longer, the division between the two oblique; without claws but bearing three or four translucent spines of which one near the end and inside of hind tarsi is much the strongest; a dark blotch ventrally near tip of all. Wings long and narrow, with microtrichia arranged in close longitudinal lines; veins of fore wing invisible but their position marked by series of setae, fore vein with six to eight near the base and two near the end, hind vein with seven more or less equally spaced, costal vein with 16 progressively longer and stronger towards end of wing and also with many long, thin, straight, rather widely spaced fringe hairs; hind fringe hairs long, thin, wavy, colorless, the first one inserted close to the basal seta of the series on the hind vein; scale with four setae dorsad on fore margin, two of same length on the median line, two much longer ones paired and rising from prominent bases ventrally near distal end. Hind wing with rather sparse fringes; the hind fringe less so than the fore fringe, its hair long and wavy.

Abdomen slender, widening gradually to segment 5, thence tapering more suddenly to end; segment 9 the longest, 10 the shortest, about one-half the length of 9, split along its entire length dorsally; setae on all segments except 8, 9, and 10 weak, short, colorless; setae on segments 9 and 10 about equally long, light brown.

Measurements of holotype (female) in mm. (paratype in parentheses): Length 1.16 (1.16); head length .1462 (.1376); head width .1462 (.1204); interocellar setae .0412; prothorax length ..... (.1376); prothorax width on hind margin ..... (.1462); abdomen length .7224 (.7310); abdomen width on

segment 5.....(.2766); fore wing length .767; outer and inner setae on hind angle of prothorax (approx.) .0546; longest setae on abdominal segments 9 and 10 (approx.) .1443.

Antennal segments (in microns)	1	2	3	4	5	6	7	8	Total
Length .....	20	37	41	33	28	53	12	16	240
Width .....	24	24	16	20	20	20	8	4	

Described from two females collected in Noumea, July; 1 female, ex sugar cane, Col de la Pirogue, September 13; and two females in spindle of sugar cane, Noumea, September 27. The male is not known.

The genus *Diarthrothrips* was erected by Williams for the species *coffaeae*, which was found injuring coffee in British East Africa and has remained up to now the only known species of the genus. The new species is apparently very close to *coffaeae* but differs, according to description and figures, in the shape of antennal segments and sense cones and in the chaetotaxy of the wings. In *coffaeae* the sense cones are strong, forked near their bases, and inserted squarely on the ventral and dorsal surfaces of each segment. In *saccharicolus* the sense cones are weak, forked near the distal end, and, at least on segment 3, inserted close to or on the outer surface of the segment. Of the ring joint sometimes visible on antennal segments 4 and 5 of *coffaeae*, there is no sign in my series of *saccharicolus*.

### Genus *Thrips* Linné

Linné, Fauna Suecica, ed. 1: 220, 1776.

Uzel, Monographie der Ordnung Thysanoptera: 173, 1895.

Priesner, Die Thysanopteren Europas: 343, 1928.

Moulton, The Thysanoptera of South America; Rev. de Ent., 3 [1]: 132, 1933.

### *Thrips tabaci* Lindeman

1883—*Thrips solanaceorum* (Widgalm) Portschinsky; Revue Mens. d'Ent. St. Petersb., 1 [3]: 44 (without description).

1888—*Thrips tabaci* Lindeman; Die schadl. Insekten d. Tabak in Bessarabien, 15: 61-75.

1921—*Thrips tabaci* Lindeman; Ahlberg, Nat. Hist. Juan Fernandez and Easter Island: 275.

1926—*Thrips tabaci* Lindeman; Karny, Studies on Indian Thysanoptera; Memoirs of the Dept. of Agric. in India, Ent. Ser., 9 [6]: 99.

1927—*Thrips tabaci* Lindeman; Moulton, Thys. of the Hawaiian Islands, Proc. Haw. Ent. Soc., 7 [1]: 111.

1928—*Thrips tabaci* Lindeman; Priesner, Die Thysanopteren Europas: 433.

1934—*Thrips tabaci* Lindeman; Moulton, The Thys. of South America; Revista de Entomologia, 3 [1]: 132.

1934—*Thrips tabaci* Lindeman; Kelly and Mayne, Monograph of the Order Thys. in Australia: 28.

1941—*Thrips tabaci* Lindeman; Bianchi, Thysanoptera and Aphididae New to the Island of Midway; Proc. Haw. Ent. Soc., 11 [1]: 37.

1944—*Thrips tabaci* Lindeman; Lever, Thrips Injury to Lettuce; Agricultural Journal (Suva, Fiji), 15 [1]: 14.

New Caledonia can now be added to the wide distribution of this ubiquitous species. Dr. Williams' collection consists of many females taken on onion plants at Nakety, October 8.

### ***Thrips imaginis* Bagnall**

1926—Bagnall: Annals and Magazine of Natural History, [9] 18: 111.

1934—Kelly and Mayne: Monograph of the Order Thysanoptera in Australia: 28.

Found commonly in all the states of Australia on a long list of hosts, wild and cultivated. Collected by Dr. Williams in Noumea, two females in a rose flower, July 11, and one female on a flower of *Lantana camara* Linn., September 26.

## Notes on Hawaiian Thysanoptera, With Description of a New Species

By FRED A. BIANCHI

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of December 11, 1944)

Suborder Tubulifera

Family Phloeothripidae Uzel

Subfamily Phloeothripinae Priesner

### *Nesothrips oahuensis* Kirkaldy

IN my paper "*Nesothrips* Kirkaldy Supersedes *Oedemothrips* Bagnall" (Proc. Haw. Ent. Soc., 12 [1]: 31, 1944) it was stated that "*Oedemothrips laticeps* Bagnall 1910 becomes *Nesothrips hawaiiensis* Kirkaldy 1907". This is a misstatement due to oversight and should read "*Oedemothrips laticeps* Bagnall 1910 becomes *Nesothrips oahuensis* Kirkaldy 1907".

In the redescription of *Nesothrips oahuensis* Kirkaldy, in the same paper, it is stated that the antennae are "approximate at base". It should have been stated that the antennae are inserted ahead of the anterior margin of the eyes and are separated by the frontal costa, which is fairly prominent, broadly emarginate in front and little narrower than the first antennal segments.

### *Haplothrips* (*Karnyothrips*) *flavipes* (Jones)

Unlike the following thrips of this paper, this species has already been reported from Hawaii (Moulton, Proc. Haw. Ent. Soc., 11: 187, 1936) and is known elsewhere as an active predator on mites and perhaps other small organisms. In Hawaii, however, it is not a species commonly collected and it is of interest to record that during February and March of the current year a number of larvae and adults were found within old egg cases of the Chinese mantid (*Tenodera angustipennis* Sauss.) at the H.S.P.A. substation, Manoa Valley. Since these egg cases are of wide distribution and almost always become infested with mites and psocids soon after their eggs hatch—or perhaps even before they hatch—they probably provide an important reservoir of *H. flavipes* in the Territory, even when other environments are quite unfavorable for the maintenance of the species.

## Subfamily Megathripinae Priesner

**Rhaebothrips major** Bagnall (pl. XVII, figs. A, B, C)

This species was originally described from Samoa (Bagnall, *Insects of Samoa*, 7, [2] : 75, 1928) and later reported by Moulton from Fiji (Occ. Papers Bishop Museum, 17 [22] : 308, 1944). Comparison of specimens recently collected in Honolulu with the Fijian specimens determined by Dudley Moulton and now in the Bishop Museum leaves no question of their identity.

The species is now mentioned from Hawaii for the first time and the opportunity is taken to redescribe it. Bagnall's original description, to judge by context, was based upon a single specimen and was stated to be a description of the female, whereas it is obviously a description of the male, the female not having been described up to now. My description of the species based on both sexes follows:

Macropterous female: Body length, partly distended, 2.89 mm. Color by transmitted light dark brown, with abdomen darker, almost black; fore tibiae and all tarsi light brown to yellow clouded with brown. All tarsi with brown macula distally. Antennal segment 3, basal three-fourths of 4, and basal third of 5 yellow. By direct light, eyes, ocellar crescents, internal pigmentation red. Striation very fine and visible only in clear specimens; transversely subreticulate on sides of head and most parts of body, longitudinally subreticulate on sides of metanotum.

Head slightly less than one and one-half times as long as wide; widening almost imperceptibly at basal third and gradually constricted thence to dark collar-like thickening at base. Vertex weakly and evenly convex between eyes. Eyes small, finely faceted, not protruding, placed on the angles of the head and about one-fourth as long as the head. Ocelli about twice the diameter of eye facets; posterior pair ahead of line through middle of eyes and not touching their inner margins; anterior ocellus forwardly directed on anterior declivity of vertex. Postocular spines almost one-third of eye-length back of their inner angles, about one and one-half times as long as eyes. Postocellar setae a little more than one-half the length of postoculars and set slightly caudo-mesad of posterior ocelli. A few other spines on dorsum and sides of head very minute. Mouth cone broadly constricted near middle and broadly rounded at end, a little less than half as long as rest of head; labrum not surpassing labium.

Antennae not quite twice as long as head; inserted a little caudad of vertex. Frontal costa rather prominent, weakly concave at end, about half as wide as first antennal segment. Antennal segments shaped as illustrated, 3 sometimes only slightly but always longer than 4. Sense cones sharply pointed, relatively thin and short, at most one-fourth the length of segment 3, always borne on or near distal lip of segment; segment 3 with one outside and one ventrally; segment 4 with a ventral and a dorsal pair; segment 5 with a dorsal pair and one ventrally; segment 6 with one on each side; segment 7 with one dorsally. Antennal hairs translucent, thin, inconspicuous.

Prothorax slightly less than half as long as head; slightly wider than head is long; the sides weakly arched and divergent; the fore and hind margins with about equal curvature, which is pronounced; median suture heavy, almost, or quite, attaining fore margin; major pronotal setae all present, paler brown than body, those paired at hind angles subequal and longest, midlaterals next in size, anteroangulars next, anteromarginals smallest. Other setae few and minute. Coxals stiff, about one-third as long as epimerals, not visible in strictly dorsal view. Pterothorax normal, subquadrate, with a pair of weak

spines on the metascutum, well back on the plate and distant from each other, with a slightly stronger seta on each meta-epimeron. Legs rather thin and long, with a few long strong hairs outwardly on femora and distally on tibiae, a particularly long one ventrally near the base of fore femora on inner margin. Fore femora normal, somewhat incrassate. Fore tarsi (under sufficient magnification) with a minute but distinct tubercle-like tooth on the inner edge of the first segment near the end.

Wings pale yellowish brown. Fore vein weakly narrowed in middle by incurving of cephalic margin. Vein of fore wing irregularly maculate with brown in about median two-thirds; vein of hind wing more regularly, narrowly and lightly maculate along basal two-thirds. Fore wing with from 15 to 18 intercallary hairs; with three subbasal hairs respectively about 53, 97, and 151 microns long from the basal one to the distal one, all placed near midline of wing, the middle one slightly out of line with the others.

Abdomen broadly ovate, widening to segment 5, more suddenly narrowed thence to base of tube. Tube about as long as head and relatively slender, slightly, roundly constricted at about distal one-eighth, with a scattering of very minute spines on dorsal surface and a pair of small circular pits dorsally on distal one-fifth. Distal hairs somewhat more than half as long as tube.

Measurements of female in mm.: Head length .356; head width .258; prothorax length .169; prothorax width (including coxae) .373; epimeral setae .133; postangular setae .142; midlateral setae .106; anteroangular setae .062; anteromarginal setae .053; postocular setae .142; postocellar setae .080; tube length .356; width of tube at base .115; width of tube at end .044.

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.062	.071	.142	.133	.106	.080	.062	.044	.700

Macropterous male: Smaller than female (body length, partly distended, 2.46 mm.) but similar in color and shape. Differing as follows: prothorax longer in relation to head (20:35 instead of 17:40), its anterior margin heavily chitinated and thickened, continuous with the pronotal suture. Fore femora much more strongly incrassate and pronouncedly curved, its inner margin making an almost right angle near the base. Basal segment of fore tarsi produced inwardly to a strong wide tooth, which is about as long as the segment is wide.

Measurements of male in mm.: Head length .311; head width .204; prothorax length .178; prothorax width .356; epimeral setae .106; postangular setae .151; midlateral setae .115; anteroangular setae .062; anteromarginal setae .036; postocular setae .142; postocellar setae .089; tube length .320; width of tube at base .097; width of tube at end .044.

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.057	.062	.124	.115	.097	.071	.053	.044	.623

Brachypterous forms: Not different from macropterous forms except for very short pad-like wings.

Described from the following material: August 24, 1943, on grass, Makiki, Honolulu, J. S. Rosa, coll., one macropterous female; January 1944, on person, Manoa Valley, Honolulu, F. A. Bianchi, coll., one brachypterous female; March 15, 1944, within old stem of wood rose (*Ipomoea tuberosa* Linn.), Makiki, Honolulu, O. H. Swezey, coll., four macropterous and one brachypterous females and two macropterous and one brachypterous males; April 1944, within dried and hollow stem of old papaya leaf, Makiki, Honolulu, F. X. Williams, coll., two macropterous males and three macrop-



terous females; April 1944, within dry pod of pigeon pea, Makiki, Honolulu, O. H. Swezey, coll., one macropterous male.

In the stems of papaya and wood rose this species is found in small colonies comprising eggs and larvae as well as adults.

**Suborder Terebrantia**

**Family Thripidae Uzel**

**Subfamily Chirothripinae Karny**

***Aptinothrips rufus* (Gmelin) var. *connaticornis* Uzel**

*Thrips rufa* Gmelin, Caroli a Linné, Syst. Nat. : 2224, 1788.

*Aptinothrips rufa* (Gmelin) var. *connaticornis* Uzel, Mon. Ord. Thys.: 154, 1895.

A complete bibliography of this species is given by Priesner (Die Thysanopteren Europas: 156, 1926). In various varieties and forms it is known from Europe, North America, and India. Like the next two species discussed, it is an inhabitant of grasses, hitherto unreported in Hawaii, and probably more or less recently introduced. Eight females and three larvae on two heads of barley (?) were found by the writer at Kilauea, Hawaii, June 22, 1944.

**Subfamily Sericothripinae Karny**

**Tribe Anaphothripini Priesner**

***Anaphothrips secticornis* (Trybom)**

*Thrips secticornis* Trybom, Öfv. Vet. Akad. Förh., 8 [8]: 620, 1896.

Complete bibliography in Priesner's "Die Thysanopteren Europas": 189. Identified by the writer from a single female collected with the preceding species on the flower heads of an introduced grass, probably barley, near the main entrance to the Bird Park, Kilauea, Hawaii, June 22, 1944. Known in North America and Europe.

***Anaphothrips obscurus* (Müller)**

*Thrips obscura* Müller, Zool. Dan. Prodrum.: 96, 1776.

A full bibliography of this species is given in "Die Thysanopteren Europas": 183. It is a notorious enemy of grasses in the United States, Canada, Europe and Australia and it is not surprising to record it now from Hawaii. It is strange, rather, that it had not been found earlier and that it has not appeared again in our collections after the instance here recorded.

Identified by the writer from numerous winged females collected from sugar cane and Sudan grass grown for experimental purposes in open greenhouses, Experiment Station, H.S.P.A., Honolulu, during January of 1941. Great numbers of winged females, larvae, and eggs were to be found on the two host plants and the damage

to both, had it not been artificially checked in time, would have obliterated the results of the experiments. On Sudan grass the damage appeared in the usual "silvering" of the leaves, while on young cane the edges of the leaves became red or reddish in longitudinal areas and partly curled back upon themselves.

#### Subfamily Thripinae

#### *Docidothrips* Priesner supersedes *Stulothrips* Moulton

In 1940, suspecting the identity of *Stulothrips trespinus* Moulton and *Docidothrips pandani* Kurosawa, I sent some specimens of *trespinus* to Mikio Kurosawa for comparison with his types. In reply to my suggestion Mr. Kurosawa stated that comparison of our material did not bear out my surmise of specific identity but that it did demand placing of both species in the same genus. By comparing my material, including paratypes borrowed from the Hawaiian Entomological Society, with the generic descriptions I am led to agree with Mr. Kurosawa. Therefore, since *trespinus* is the genotype of Moulton's genus and is antedated by *Docidothrips*, I propose that *Docidothrips* Priesner (Konowia 12 [3, 4] : 314, 1933) shall supersede *Stulothrips* Moulton (Proc. Haw. Ent. Soc., 8 [3] : 499, 1934).

#### *Taeniothrips cyperaceae* sp. nov. (pl. XVII, figs. D, E)

Macropterous female: Color by direct light, cadmium-yellow; by indirect light, orange-yellow with brownish mottling particularly abundant on sides; legs paler; wings weakly and uniformly washed with yellow; extreme end of tenth abdominal segment often orange; ocellar crescents red to orange; eyes purplish to black. Antennal segment 1 pale yellow, often nearly colorless; other segments uniformly greyish yellow, darker than 1 but always lighter than body.\*

Head wider than long; vertex weakly concave next to eyes, weakly convex in middle; cheeks almost straight, weakly or not at all convergent; occiput inconspicuously striate transversely. Frontal costa deeply, roundly excavate at apex. Eyes somewhat protruding, occupying about half the head length, with about eight facets on outer outline and some coarse, colorless spines among the facets. Ocelli larger than facets; set close together on a mound equidistant from the front and hind margins of the eyes. Interocellar setae pale but conspicuous and nearly one-half as long as head; set within the ocellar triangle, just ahead of the posterior ocelli. A series of three or four short, colorless setae arching back of each eye from the postocellars, which are only slightly, if at all, longer. Mouth cone shorter than the rest of head exclusive of frontal costa, broadly constricted in the middle and broadly rounded at the end; labrum not surpassing labium and brown at tip; maxillary palpi relatively strong, the second and third segments of about equal length.

\*The color as given is that of specimens that have apparently bleached somewhat in the mounting fluid; living specimens suspended in glycerine are yellow with the sub-hypodermal pigment appearing through as darker orange mottling, with the head lighter, not mottled; legs still lighter and not mottled but lightly washed with grey; antennal segments 3 to 8 definitely grey, light at base of 3 and 4; antennal segment 2 concolorous with head, and antennal segment 1 as described above; a transverse band of brown along the median two-thirds of hind margin on abdominal segments 2 to 5; larger setae on head and body from yellow to light brown; wings yellowish grey.

Antennae shaped as illustrated, about three times as long as head; characterized by the relative paleness of segment 1; by the small, straight, sharp, forked sense cones on segments 3 and 4; by the deeply rounded notch at the apex of the inter-antennal costa; and by the shape of segment 3, which is conspicuously constricted at about one-fifth of its length above the pedicel and is sharply divided from the pedicel by a thin overhanging fold which appears under magnification as a dark line. Segment 5 with a small sense cone outwardly; 6 with a small cone outwardly and a longer one inwardly. Antennal hairs pale and inconspicuous, one-third the length of longest segment.

Prothorax almost straight on back and front margins; the sides weakly arched and slightly divergent; the hind angles rounded. Paired setae on posterior angles pale but long and strong, nearly half the length of the prothorax. A small seta between each postero-angular pair, four others on the hind margin, and several others on the sides and disk of the prothorax, relatively long but very pale and difficult to distinguish. Pterothorax normal, wider than prothorax; mesoscutum with a pair of setae at each side near hind margin; metascutum with one seta at each fore angle near anterior margin and a stronger pair medianly and removed from anterior margin by little less than their own length; all of these setae pale and difficult to distinguish.

Legs normal, beset with rather long, thin, colorless hairs; posterior tibiae on their inner edge with a row of about eight stiff thornlike setae which end in a pair longer and thicker than the others; tarsi with the usual dark distal macula.

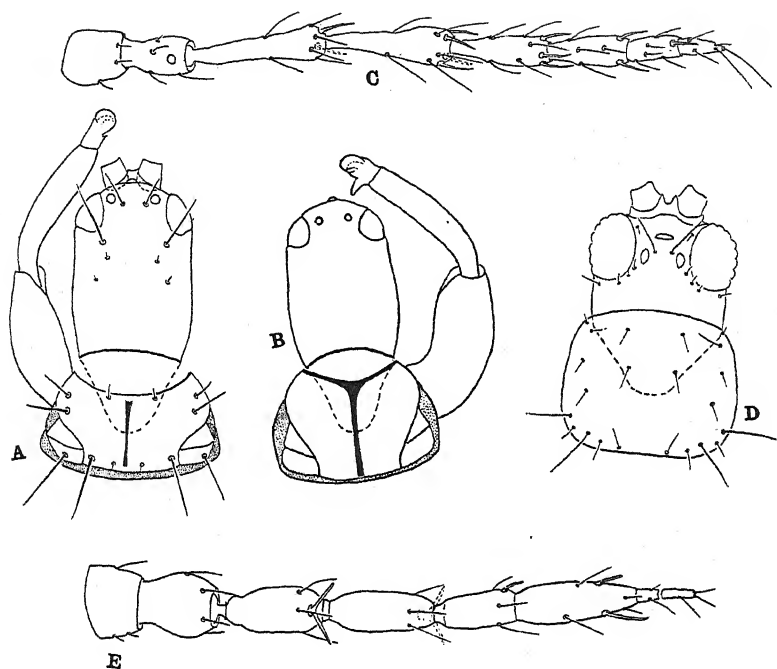
Wings long and narrow; veins of fore wing hardly apparent; fore vein with seven setae basally and two close together near distal end of wing; hind vein with 14 equally spaced; costa with about 18. Scale with five setae on anterior margin and one on disk near base. Vein of hind wing slightly darker than disk from about basal fifth of wing to near tip. Hind fringe of both wings long and wavy. Front fringe rather sparse on both wings and beginning at about basal fourth on fore wing.

Abdomen relatively long and narrow, with sides practically parallel from segment 3 to 8, thence suddenly converging to end of 10 which is roundly blunt. Abdominal setae all colorless and all inconspicuous except those on segments 9 and 10. Segment 10 without suture or cleft dorsally and segment 8 without distal fringe.

Measurements of female holotype in mm.: Head length .098; head width .155; prothorax length .143; prothorax width .192; outer seta on hind angle of prothorax .069; inner seta on hind angle of prothorax .069; interocellar setae .049; postocellar setae .012; dorsal setae on 9th abdominal segment .086; lateral setae on 9th abdominal segment .090; distal setae on 10th abdominal segment .114; total body length 1.26 (fully distended 1.49).

Described from the holotype and 11 female paratypes collected by J. S. Rosa in a jar full of nutgrass (*Cyperus rotundus* Linn.) cut on the grounds of the Experiment Station, H.S.P.A., Honolulu, August 28, 1940; two females collected by the writer in the same manner and place on December 13 of the same year; and two females collected by the writer on leaves of *Solanum nigrum* Linn. at Waialua Plantation, Oahu, on January 27, 1941. The male is unknown.

I have compared this new species with Mr. Moulton's holotype of *Taeniothrips leptosperon*, from New Guinea and also collected on a sedge, and find the two species closely related but not identical.



# PLATE XVII

A—*Rhaebothrips major* Bagnall. Head, prothorax and left fore leg of macropterous female.

B—*R. major*. Head, prothorax and right fore leg of macropterous male, with all setae omitted.

C—*R. major*. Left antenna of female, dorsal view.

D—*Taeniothrips cyperaceae* sp.n. Head, prothorax and basal antennal segments of macropterous female.

E—*T. cyperaceae*. Left antenna of female, dorsal view with some minor setae omitted.

They are similar in size, general color and shape, but can be distinguished as follows:

1. The wings of *leptospteron* are distinctly brown and several shades darker than the wings of *cyperaceae*.

2. The forked sense cones of *leptospteron* are long, strong and more or less curved in the usual manner of most *Taeniothrips*. In *cyperaceae* they are short, thin, and practically straight out at right angles from the longitudinal axis of the antenna, as shown in the accompanying illustration.

3. In *leptospteron* there is a straight, transverse series of four nearly equal setae just back of the fore margin of the metascutum. In *cyperaceae* the median pair is somewhat stronger than the outer pair and is set much farther back from the fore margin of the sclerite.

## Notes on Two Fijian Tingitids (Hemiptera)

By C. J. DRAKE and M. POOR HURD

Ames, Iowa

(Presented at the meeting of October 9, 1944)

IN our paper entitled "Fijian Tingitidae (Hemiptera)" (Occasional Papers of Bernice P. Bishop Museum, 17 [15]: 191-205, 7 figs., 1943), we were in doubt regarding the identification and distribution of two Fijian species of lacebugs which Kirkaldy had also recorded from other widely separated localities. Since the pub-

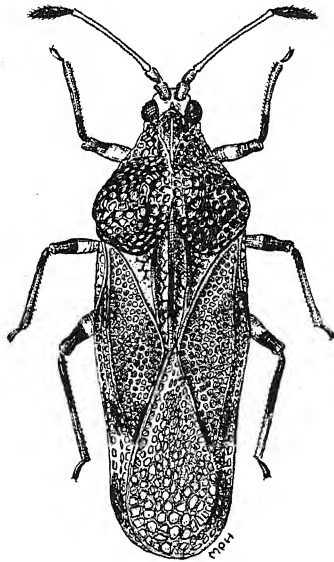


Fig. 1. *Cysteochila vitilevuana* Drake and Poor. (Paratype)

lication of the above article, we have received from Mr. Elwood C. Zimmerman notes and a photograph of a specimen upon which Kirkaldy based his determination. The species concerned are discussed below.

***Cysteochila vitilevuana* Drake and Poor (fig. 1)**

*Monanthia natalensis* Kirkaldy (not Stål), Linn. Soc. N. S. Wales, Proc. 33: 366, 1908.

*Cysteocheila vitilevuana* Drake and Poor, Occ. Papers Bishop Mus., 17, [15]: 193, 1943.

A photograph of the specimen from Fiji bearing the identification label "*Monanthia natalensis* Stål" in Kirkaldy's handwriting is without question the species described by Drake and Poor as *Cysteocheila vitilevuana*. As we have pointed out (1943), *Physatocheila natalensis* Stål (Öfv. Vet-Akad. Förh., 12: 38, 1855) from Africa, later illustrated by Distant (*Monanthia natalensis*, South Afr. Mus., Ann. 2: 242, pl. 15, fig. 10, 1902), is very different and a distinct species which should not easily be confused with the newer one, though from Distant's figure it would appear to belong to the same genus. A female paratype of *Cysteocheila vitilevuana* from Viti Levu, Fiji, is figured by Mrs. Hurd.

We are glad to be able to clear up this point of confusion and to demonstrate that one species does not occur in both Fiji and Africa, a distributional phenomenon which would be difficult to explain.

Inadvertently a line was omitted from the original description of *vitilevuana* (p. 194) and after the word "carinae" (line 14) should be inserted: "becoming obsolete anteriorly. Elytra narrow, subparallel, moderately—"

#### ***Ulonemia pacifica* (Kirkaldy)**

*Teleonemia pacifica* Kirkaldy, Linn., Soc. N. S. Wales, Proc., 32: 780, 1907.

*Ulonemia pacifica* (Kirkaldy); Drake and Poor, Occ. Papers Bishop Mus., 17 [15]: 193, 1943.

The fact that the type specimens of this species were collected in the Fiji Islands and Australia suggests the possibility that two species may be represented in the series. On this account it is advisable to designate as the type of *T. pacifica* the single specimen from Rewa, Fiji, collected by Muir in 1906 and labeled by Kirkaldy, "type", in the collection of the Hawaiian Sugar Planters' Association of Honolulu. We pointed out in our 1943 paper that a male from Lami, Viti Levu, Fiji, taken by C. E. Pemberton in 1920, agrees fairly well with the original description, as do also the Fijian specimens collected by Mr. Zimmerman. We have seen no Australian specimens determined by Kirkaldy as *T. pacifica*.

In his collection of Australian tingitids, H. H. Hacker (Queensland Mus., Mem. 9: 24, 1927) determined as *Tingis* (*Tropidocheila*) *trivirgata* Horvath (Ark. Zool. 17A: 6, 1925) some Queensland specimens which are very similar in size and general appearance to *T. pacifica* Kirkaldy. Because of the similarity of several other Australian forms, Horvath's original description is not adequate for determining his species without examining the types. As *pacifica* Kirkaldy is the older name, it will remain valid regardless of the number of species which finally emerge from the confusion.

The specimens from Fiji differ from the Australian ones in having the femora of all three pairs of legs broadly banded at the middle with pale fuscous; the femora of the Australian specimens are uniformly yellowish brown. The color markings of the reticulations vary slightly in the specimens from both countries. Except for the markings on the femora, the specimens from the two regions are very closely related, and more material is needed to determine the limits of variation.

It will be especially interesting to discover whether or not one species does occur both in Fiji and Australia, because among the many species known from these two regions, almost all of which we have studied, there is no other record of such a distribution. It will be necessary to see Horvath's type of *trivirgata* and the type specimens of Kirkaldy's *pacifica* from Australia before the problem can be settled definitely.





## Some Phases of Federal Plant Quarantine Work in Hawaii

By RICHARD FAXON

United States Department of Agriculture  
Agricultural Research Administration  
Bureau of Entomology and Plant Quarantine

(Presidential address, delivered December 11, 1944)

To plant quarantine inspectors the entomological history of Hawaii presents many elements of interest. In addition to the classic examples of biological control of insects, and important taxonomic studies, pioneer work was done in protecting the agriculture and forests of Hawaii from plant diseases and injurious insects by the enforcement of quarantine laws. Under the monarchy a Bureau of Agriculture and Forestry was established in the Department of Interior. One of its objects was "to guard against the introduction of plant diseases or insect pests, and to render aid in the suppression of blights and diseases affecting agricultural products and live stock". The Session Laws of 1888 included "An Act to Prevent the Introduction of Coffee Leaf Diseases" and in 1890 "An Act Relating to the Suppression of Plant Diseases, Blight and Insect Pests". The Penal Laws of the Republic (1896) provided for the reporting through customs officers of the presence of plants on board ships from foreign ports and the inspection and disposition of such plants by the Commissioners of Agriculture. The present Territorial law places responsibility for enforcing plant quarantine regulations in the Board of Commissioners of Agriculture and Forestry through its division of entomology.

### THE MEDITERRANEAN FRUIT FLY IN HAWAII

The melon fly (*Dacus cucurbitae* Coq.) had been in the Hawaiian Islands for many years and the discovery of the Mediterranean fruit fly (*Ceratitis capitata* [Wied.]) in 1910 added another serious pest of this type. As these fruit flies were of great concern to fruit growers, the Board of Commissioners of Agriculture and Forestry on October 6, 1910, requested E. M. Ehrhorn, superintendent of entomology, to notify the California Horticultural Commission of the appearance of the Mediterranean fruit fly on Oahu. About a year later, November 1, 1911, the Board appointed Walter M. Giffard director of fruit fly control, and in December 1911, California sent H. A. Weinland to Hawaii as an inspector to aid in reducing the danger fruit fly introduction in that state. A vigorous

campaign was carried on to reduce the fruit fly population and to prevent its spread. Notwithstanding these efforts, the Mediterranean fruit fly had been found on all the other larger islands, except Lanai, by the end of 1912.

In 1912 Congress appropriated \$35,000 for the study of the Mediterranean fruit fly and E. A. Back, of the Bureau of Entomology, United States Department of Agriculture, was designated to take charge of the investigation of this insect in Hawaii. He arrived in Hawaii on August 29, 1912, accompanied by C. L. Marlatt, assistant chief of the Bureau, and also chairman of the Federal Horticultural Board. Dr. Back took over the work on the Mediterranean fruit fly in the Territory on September 15, 1912, except the collection and introduction of parasites. The Territory had employed F. Silvestri to aid in collecting such material. After conferring with W. M. Giffard, president of the Board of Commissioners of Agriculture and Forestry, and E. M. Ehrhorn, superintendent of entomology, Dr. Marlatt, as chairman of the Federal Horticultural Board, recommended the appointment of Mr. Ehrhorn as collaborator of the latter Board with the Secretary of Agriculture. His appointment on December 1, 1912, gave Mr. Ehrhorn authority to enforce the Federal Plant Quarantine Act of August 20, 1912, and the foreign quarantines promulgated under its provisions. The same arrangement has been carried on with Mr. Ehrhorn's successors, L. A. Whitney and Noel L. H. Krauss, as plant quarantine officers for the Territory.

#### FEDERAL QUARANTINES AFFECTING TRAFFIC BETWEEN HAWAII AND THE MAINLAND

The development of Federal quarantines affecting traffic in plants and plant products between Hawaii and the other parts of the United States, under the provisions of the Plant Quarantine Act, required a period of many years. The following list is effective at present: Quarantine No. 13, Mediterranean Fruit fly and Melon fly; Quarantine No. 16, Sugarcane; Quarantine No. 30, Sweetpotato and Yam; Quarantine No. 32, Banana Plant; Quarantine No. 47, Hawaiian and Porto Rican Cotton, Cottonseed, and Cottonseed Products; Quarantine No. 51, Sugarcane, Corn, Cotton, Alfalfa, and Fruits of Avocado and Papaya from the United States to Hawaii; Quarantine No. 60, Sand, Soil, or Earth, with Plants.

*Quarantine No. 13:* Very soon after Dr. Back took over fruit fly investigations in Hawaii, the Secretary of Agriculture promulgated Notice of Quarantine No. 2 on September 18, 1912. This order prohibited the entry into the mainland of Mediterranean fruit fly hosts from Hawaii. (Only bananas and pineapples were permitted to enter California from Hawaii under Quarantine Order No. 6 of the California Commission of Horticulture.) Notice of

Quarantine No. 2 was superseded by Quarantine No. 13, effective May 1, 1914, which mentions both the Mediterranean fruit fly and the melon fly as causes for quarantine action. In its original form Quarantine No. 13 prohibited the movement from the Territory of Hawaii into the rest of the United States of any fruit or vegetable upon which either the Mediterranean fruit fly or the melon fly breeds. Bananas and pineapples were included in an extensive list of such hosts, but provision was made by regulation for shipment of these two fruits after inspection and certification by the United States Department of Agriculture as free from infestation with the two fruit flies in question. The quarantine was amended several times in order to clarify the regulations and to expand the list of fruit and vegetables that could be shipped after inspection and certification. The first additions to the permitted list were taro and coconuts. Later lily root, ginger root, and "gobo", or burdock (*Arctium lappa*), were added. The present revision of Quarantine No. 13 became effective June 1, 1917. It prohibits the movement of all fruits and vegetables in the natural or raw state from the Territory, except in manner or method or under conditions prescribed in regulations of the Secretary of Agriculture. Under revised rules and regulations effective June 1, 1930, six fruits and vegetables are permitted shipment under certification: Bananas of the noncooking type, pineapples, taro, coconuts, lily root, and ginger root. Provision is made for the certification of other fruits and vegetables that cannot be the means of conveying either the Mediterranean fruit fly or the melon fly. Under this provision 40 fruits and vegetables have been added to the six listed in the revision of 1930. The complete list is as follows: Arrowhead (*Sagittaria sagittifolia*), arrowroot (*Maranta arundinacea*), asparagus (*Asparagus officinalis*), bean sprouts, mung (*Phaseolus aureus*), bean sprouts, soy (*Glycine hispida*), burdock, great (*Arctium lappa*, *Lappa major*, *L. edulis*), butterbur (*Petasites japonica*), cabbage (*Brassica oleracea*, *B. pekinensis*, *B. chinensis*), carrot (*Daucus carota*), cassava (*Manihot* sp.), celery (*Apium graveolens*), Chinese spinach (*Amaranthus gangeticus*), chives (*Allium schoenoprasum*), chrysanthemum, garland (*Chrysanthemum coronarium*), coriander (*Coriandrum sativum*), dandelion (*Taraxacum officinale*), dropwort, water (*Oenanthe stolonifera*), garlic (*Allium sativum*), ginger bracts (*Zingiber mioga*), honewort (*Cryptotaenia canadensis*), Jesuit's nut (*Trapa bicornis*, *T. natans*), kudzu (*Pueraria thunbergiana*), leek (*Allium porrum*), lettuce (*Lactuca sativa*), Malabar-nightshade (*Basella rubra*), mugwort (*Artemisia vulgaris*), onion, green (*Allium fistulosum*), parsley (*Petroselinum hortense*), pea, edible podded (*Pisum sativum macrocarpon*), perilla (*Perilla frutescens*), potato (*Solanum tuberosum*), radish (*Raphanus sativus longipinnatus*), spinach (*Spinacia oleracea*), swamp cabbage (*Ipomoea reptans*), sweetcorn (*Zea mays*), taro

root, shoots and stalks (*Colocasia esculenta*), watercress (*Nasturtium officinale*), waternut (*Eleocharis tuberosa*) or waterchestnut (*Scirpus tuberosus*), yambean root (*Pachyrhizus erosus*), yams (*Dioscorea* spp.).

A number of violations of Quarantine No. 13, one as late as 1930, resulted in fines for the offenders and valuable publicity in the enforcement of the quarantine. The Post Office Department was also very helpful in notifying the postmasters in the Territory of the requirements of the quarantine order.

Administrative Instructions have been issued under the provisions of Quarantine No. 13 for various treatments of prohibited fruits and vegetables in Hawaii under supervision of Bureau inspectors. B.E.P.Q.-481, effective November 1, 1938, outlines two treatments, refrigeration at 35° F. for 15 days, or heating in saturated air at 110° F. for 8 hours. B.E.P.Q.-510, effective August 1, 1940, provides for the certification of guavas, papayas, bell peppers, bitter melon, cucumbers, summer squash, string beans, and tomatoes, for shipment to the mainland, after fumigation with methyl bromide for 3½ hours, at a dosage of 2 pounds to 1,000 cu. ft. and temperature not lower than 80° F. B.E.P.Q.-462, effective September 15, 1937, includes frozen-pack fruits from Hawaii in its provisions. Shipments may be made only under permits issued in advance. Fruits subject to attack by plant pests not killed by the refrigeration treatment prescribed may not be authorized for shipment. Fruits must be frozen solid before or after packing and their temperatures must be 20° or below at the time of arrival.

*Quarantine No. 16:* The domestic sugarcane quarantine, Notice of Quarantine No. 16, was issued June 6, 1914, and was effective on the same date. On account of certain injurious insects and fungous diseases existing in Hawaii and Puerto Rico, the movement of living canes of sugarcane, or cuttings or parts thereof, to the mainland was declared unlawful. With the change in the foreign sugarcane quarantine No. 15 to include bagasse in addition to living canes and its extension to protect Hawaii and Puerto Rico, the domestic sugarcane quarantine No. 16 was revised, effective January 1, 1935, to include bagasse as well as canes of sugarcane, cuttings, or parts thereof, or sugarcane leaves as prohibited material. Provision was made for the importation of the prohibited articles by the United States Department of Agriculture for scientific or experimental purposes, and the entry of specific materials under permit when authorized by the Department. Under this provision numerous shipments of bagasse have been permitted from Hawaii for investigational and manufacturing purposes when their movement involves no pest risk.

*Quarantine No. 30:* After the customary hearing, the domestic quarantine on sweetpotatoes and yams was adopted and became

effective January 1, 1918. This quarantine prohibited the movement of the two vegetables from Hawaii and Puerto Rico to the mainland, and was promulgated on account of the presence of two insects in Hawaii and Puerto Rico, i.e., *Cylas formicarius* (Fabr.) and *Euscepes batatae* \* (Waterh.) which has been reported as infesting sweetpotatoes (*Ipomoea batatas*) and yam (*Dioscorea* spp.). A revision of Quarantine No. 30, approved October 4, 1934 (effective October 10, 1934), removed the prohibition against the movement of *Dioscorea* spp., and the sweetpotato stem borer (*Omphisa anastomosalis* [Guen.]) was added to the sweetpotato scarabee (*Euscepes batatae*\*) as a reason for quarantine action.

*Quarantine No. 32:* After a public hearing held on March 4, 1918, Notice of Quarantine No. 32, Banana Plant Quarantine (Domestic), was issued, effective April 1, 1918. This quarantine prohibits the movement of any species of banana plants from Hawaii and Puerto Rico to the mainland, on account of the existence of two weevils which attack banana plants and sugar cane: *Rhabdocnemis obscura*† (Bdv.) in Hawaii and *Metamasius hemipterus* (Linn.) in Puerto Rico. Provision is made for importations of banana plants by the United States Department of Agriculture for experimental purposes. The quarantine does not affect the shipment of the fruit of the noncooking type of bananas from Hawaii.

*Quarantine No. 47:* The restriction on the movement of cottonseed and cottonseed hulls from Hawaii was first issued on June 24, 1913, as Notice of Quarantine No. 9. Later Quarantine No. 23 was promulgated on February 11, 1916, which regulated the movement of cotton from Hawaii into any part of the United States. These earlier quarantines were superseded by Quarantine No. 47, effective August 15, 1920, which regulates the movement of Hawaiian and Puerto Rican cotton, cottonseed, and cottonseed products. In addition to the pink bollworm (*Pectinophora gossypiella* [Saund.]), which was the basis for the earlier quarantine action against Hawaiian cotton, the cotton blister mite (*Eriophyes gossypii* Banks), another pest of cotton, was known to exist in Puerto Rico. The regulations prohibit the entry into the mainland of the United States of Hawaiian and Puerto Rican seed cotton, cottonseed, and cottonseed hulls. Ginned cotton, cottonseed cake, meal, and other cottonseed products from Hawaii and Puerto Rico may be shipped under permit issued by the Secretary of Agriculture, but are permitted to enter only through the ports of New York, Boston, San Francisco, and Seattle, or other port designated in the permit. Cotton is allowed to enter only by an all-water route. The importation of cottonseed oil from Hawaii and Puerto Rico is unrestricted.

\*Now known as *Euscepes postfasciatus* (Fairm.) [Ed.].

†*Rhabdoscelus* Marshall (1943) is now the accepted name for this genus of beetles [Ed.].

*Quarantine No. 51*: In order to protect Hawaii from a number of injurious insects known to infest certain crops on the mainland, Quarantine No. 51 was promulgated, effective October 1, 1921. The following insects were listed in the quarantine as potential pests of Hawaiian crops: The sugarcane moth borer (*Diatraea saccharalis* [Fabr.]), the alfalfa weevil (*Hypera postica* [Gyll.]), the cotton boll weevil (*Anthonomus grandis* Boh.), the papaya fruit fly (*Toxotrypana curvicauda* Gerst.) and certain insects attacking the fruit of the avocado. The regulations restrict the movement of sugarcane, corn, cotton, and alfalfa plants or parts thereof, and the fruits of avocado and papaya. When carried as ship's stores, or by passengers and crews on coastwise ships en route to Hawaii, they must be consumed or removed from such ships before arrival at Hawaiian ports, and the ships must be sterilized.

*Quarantine No. 60*: The restriction of the movement of sand, soil, or earth from Hawaii and Puerto Rico to the mainland was first considered at a public hearing on March 7, 1922. Quarantine action was considered necessary because of the existence in those islands of several beetles and termites, which might be carried in soil with plants. Action was delayed, however, and the Hawaiian and Puerto Rican Quarantine covering sand, soil, or earth, with plants, Quarantine No. 60, became effective March 1, 1926. It was revised effective September 1, 1936. This quarantine prohibits the shipment of sand (other than clean ocean sand), soil, or earth, around the roots of plants, from Puerto Rico and Hawaii to the mainland of the United States because the following insects might be transported in such material: *Phyllophaga* spp. (white grubs), *Phytalus* sp., *Adoretus* sp., and several species of termites, or white ants. Numerous shipments of soil free from roots of plants and other plant material, and free from all stages of insects, have been allowed to move from Hawaii to the mainland for experimental purposes. The shippers have cooperated in safeguarding all such shipments from possible insect infestation.

#### APPLICATION OF QUARANTINES

The application of the quarantines just described has been a gradual development. It has had several phases such as the certification of fruits and vegetables after inspection, and later after treatment, the inspection of parcel-post packages before they leave Honolulu for the mainland, and the inspection and certification of airplanes before departure to the West Coast of the United States. Inspections have been made of express packages also and of hold baggage on departing ships.

Certification of Hawaiian fruits and vegetables, in accordance with the provisions of Quarantine No. 13, was carried on by E. A. Back and C. E. Pemberton, of the Bureau of Entomology, United

States Department of Agriculture, in conjunction with the investigations of the Mediterranean fruit fly and the melon fly. This work was transferred from the Bureau to the Federal Horticultural Board when H. F. Willard became an officer of the Board in 1928. At the beginning, bananas and pineapples were the only fruits certified. As already stated, the list of fruits and vegetables was expanded in accordance with the demand on the part of shippers, and when it could be determined that there was no risk of transporting fruit flies with the products in question. Inspections in the field naturally increased to determine whether the fruits and vegetables were being properly handled to avoid contamination with possible sources of fruit fly infestation. The inspections included the survey of adjacent premises, as well as packing houses, packing material, and the fruits and vegetables that were permitted entry.

Refrigeration treatment for Hawaiian fruits to kill the eggs, larvae, and pupae of the Mediterranean fruit fly was first proposed by E. A. Back in 1916. Extensive experiments were conducted by Dr. Back and C. E. Pemberton from 1916 to 1918 with Hawaiian fruits at various temperatures. Results showed that "no stage of the Mediterranean fruit fly can survive refrigeration for seven weeks at 40° to 45° F., for three weeks at 33° to 40° F., or for two weeks at 32° to 33° F."<sup>1</sup>

Heat treatment was developed in Florida during the campaign against the Mediterranean fruit fly and was studied further under Hawaiian conditions at the fruit fly laboratory of the Bureau of Entomology and Plant Quarantine and the Hawaii Agricultural Experiment Station at Honolulu. Administrative instructions in B.E.P.Q.-481, effective November 1, 1938, authorized the sterilization of Hawaiian fruits and vegetables by cooling until the approximate center of the fruit or vegetable reaches 35° F. and holding it at that temperature for 15 days, or heating until the approximate center reaches 110° F., and holding for 8 hours. Extensive tests under varying conditions had shown that either of the above treatments would kill all stages of both the Mediterranean fruit fly and the melon fly. Papaya, avocado, and tomato have been treated commercially by one or both of these treatments in Hawaii. Papayas have been successfully shipped to the mainland of the United States after having been given the heat treatment. Over 200,000 pounds were certified in the fiscal year ended June 30, 1940, nearly 275,000 pounds in the year ended June 30, 1941, and up to December 7, 1941, over 100,000 pounds were certified. Several shipments of avocados were certified under the cold treatment in 1939, but this method of sterilization was apparently abandoned.

The methyl bromide fumigation treatment for guavas, papayas, bell peppers, bitter melon, cucumbers, summer squash, string beans,

<sup>1</sup>The Mediterranean Fruit Fly in Hawaii, E. A. Back and C. E. Pemberton. U. S. Dept. Agr. Bul. 536: 109, 1918.



and tomatoes, authorized in B.E.P.Q.-510, effective August 1, 1940, so far has not been used extensively. A few trial shipments of tomatoes given this treatment were made in 1941.

### PARCEL-POST INSPECTION

The inspection of parcel-post packages in the Honolulu Post Office before departure for mainland destinations was inaugurated by H. F. Willard, inspector in charge of the Division of Foreign Plant Quarantines, on November 1, 1930. Mr. Willard had been connected with the Bureau of Entomology and the Federal Horticultural Board since 1914, being associated with Dr. Back and C. E. Pemberton, and took over the office of inspector when Mr. Pemberton left to join the Army in 1918. Previously the inspection of such packages had been performed on the West Coast, mainly by collaborators of the Federal Horticultural Board in San Francisco. At the beginning of this new activity Mr. Willard had the assistance of James T. Watt, who was transferred to Honolulu to supervise the per diem employees engaged for this work. A large percentage of the packages were opened and the contents examined, until it became evident that it was not necessary to inspect packages the origin of which would indicate that the presence of contraband plant material was very unlikely. Mr. Willard obtained the cooperation of several Honolulu firms, who agreed to see that no contraband plant material left their stores in packages addressed to the mainland. For many years the Post Office Department had cooperated with the Federal Horticultural Board in impressing on postmasters in Hawaii the importance of compliance with plant quarantine orders. Mr. Willard also obtained publicity through the local papers, which stressed the necessity for care in mailing native plant material to the mainland. A great many objectors to the new procedure called on Mr. Willard to register their protests but he was able to send them away convinced of the need for inspection. Apparently the steps taken in the early years of this phase of plant quarantine inspection were very effective, as there has been a marked decrease in the amount of contraband intercepted.

After December 7, 1941, R. G. Oakley, inspector in charge, arranged with the censorship authorities for the examination of parcel-post packages on a cooperative basis. Under this arrangement plant quarantine inspectors hold up packages containing censorable material and postal censors turn over mail containing plant material to Foreign Plant Quarantine inspectors. This obviously is of mutual benefit and has resulted in numerous interceptions of contraband plant material in first-class mail, which would not ordinarily be available to inspection by plant quarantine officials. Since late in August 1943 over two-thirds of the parcel-post packages inspected in Honolulu pass through the 15th Base Post Office at Fort Shafter, and the rest through the Honolulu Post Office.

During recent years the most frequent interceptions have been of raw cotton in the form of locks and bolls picked and mailed to the mainland, often to southern States, by members of the armed forces. Pink bollworms are frequently found in the seed. A tabulation of interceptions made in parcel post in Honolulu from April 1, 1943, to March 31, 1944, showed nine violations of Quarantine No. 13 (Mediterranean Fruit fly and Melon fly), 13 violations of Quarantine No. 16 (Sugarcane), one violation of Quarantine No. 32 (Banana Plant), and 49 violations of Quarantine No. 47 (Cotton, Cottonseed, and Cottonseed Products).

#### INSPECTION AND CERTIFICATION OF AIRPLANES

Another important inspection activity of the Division of Foreign Plant Quarantines in Hawaii, inaugurated by Mr. Willard, is the inspection and certification of airplanes departing for the mainland of the United States. This service was set up when the Pan American Airways Inc. began their flights to the Orient in October 1936. It appeared desirable to complete all inspections in Honolulu before the Clippers left the Pearl City airport for the West Coast. L. A. Whitney, collaborator, and Mr. Willard, in cooperation with the United States Public Health Service and the United States Customs, worked out a procedure for handling the inspection of planes arriving from the Orient. The subsequent clearing of the planes when they continued on to the mainland has been the responsibility of the Foreign Plant Quarantines office. Plant quarantine inspectors board the planes before departure to determine their freedom from plant material. Then all baggage and cargo are checked before being taken on board. Certificates are prepared which give the facts as to the condition of the planes. Before the war began a large number of flower leis certified by inspectors of the Territory were frequently carried as air express. The certificates may be picked up at destination by the plant quarantine inspectors, who can check any plant material on board. Pan American Airways officials have cooperated from the start in carrying out the inspection procedure and in instructing their passengers concerning plant quarantine regulations. The inspection and certification of airplanes in Honolulu aims to prevent the carrying of fruits and vegetables that may be infested with injurious insects out of the Territory, instead of intercepting them at destination on the mainland. At the same time it makes unnecessary plant quarantine inspection of baggage upon arrival on the mainland and avoids considerable delay for through passengers who may have very little time to make overland connections.

The Japanese attack on Pearl Harbor on December 7, 1941, caused only a slight break in the certification of Pan American Airways Clippers. One Clipper landed and returned from Hilo,

but the Pearl City base was in use again immediately, although flights were conducted with utmost secrecy. The development of air transport by both Army and Navy, however, has increased the amount of plant quarantine inspection tremendously. Certification of Navy transport planes has been carried on, along with the planes operated for the Navy by P.A.A. The Air Transport Command arranged to house two plant quarantine inspectors at Hickam Field to certify Army planes departing for the mainland, as well as those operated for A.T.C. by United Air Lines and Consolidated Vultee Aircraft Corp.

The amount of contraband plant material intercepted on board planes is not large, considering the number of planes leaving Hawaii for the mainland. This is apparently due to the educational campaign which has been carried on by all concerned to acquaint the public and the Air Force with plant quarantine restrictions. Avocados, papayas, and sugar cane from the Islands are occasionally intercepted.

When the war is over plant quarantine inspectors will no doubt resume the inspection of baggage bound for the mainland, which has been performed by customs inspectors during the war. If the volume of traffic is as large as expected, this will mean a corresponding increase in plant quarantine inspection, a problem which deserves careful study by the Territorial and Federal plant quarantine officers.

## Research on DDT for the Control of Agricultural Insects in Hawaii<sup>1</sup>

By F. G. HOLDAWAY

Entomologist, University of Hawaii Agricultural Experiment Station

(Presented at the meeting of July 10, 1944)

FOR nearly six months research has been in progress at the University of Hawaii Agricultural Experiment Station on dichlorodiphenyltrichloroethane (DDT). Much more work needs to be done before general recommendations for field application can be made. The results to date are so outstanding, however, as to warrant report and discussion at this time.

In this work I have been assisted by the staff of the entomology department of the Experiment Station and, through a cooperative project, by the entomologists of the fruit fly laboratory of the United States Bureau of Entomology and Plant Quarantine. T. Nishida has assisted with work on rose beetle, greenhouse white fly, and melon fly; William C. Look with work on greenhouse white fly, tomato bug, corn earworm, and melon fly; and O. C. McBride and M. McPhail with work on melon fly. In the studies on melon fly in tomatoes, which have involved the complex of insects of tomato, all cooperators have worked as a team. Each cooperator will figure as a co-author of the technical papers on the various problems on which he has worked. The first technical article, one with T. Nishida on DDT for the control of Chinese rose beetle, has already been forwarded to the Journal of Economic Entomology (3).<sup>\*</sup> One with O. C. McBride on the toxicity of DDT for melon fly (6), and one with T. Nishida and William C. Look on the effect of DDT on greenhouse white fly (4) are in preparation.

### GREENHOUSE WHITE FLY, *Trialeurodes vaporariorum* (Westwood)

Although DDT, or "gesarol"<sup>2</sup> as it was known when we obtained our first supplies, was secured initially for work on Chinese rose beetle, the first insect on which it was tested was greenhouse white fly, *Trialeurodes vaporariorum*. This insect has been present in Hawaii for over half a century. Since 1941 it has become a limit-

<sup>1</sup>Published with the approval of the Director as Technical Paper No. 126 of the Hawaii Agricultural Experiment Station.

<sup>\*</sup>Figures in parentheses refer to literature cited at the end of the article.

<sup>2</sup>Gesarol is the trade name for certain of the DDT products prepared and supplied by the Geigy Company Incorporated.

ing factor to green bean production in the Waianae section of Oahu where, up to 60 per cent of the green beans grown on this island were normally produced (2). In the latter part of 1943 and in the early part of 1944 devastating injury similar to that in Waianae occurred in the Waiahole district of Oahu, while reports of serious infestations have been received from the islands of Hawaii and Maui. Heavy infestation of green bean have been observed by the writer at Olinda, Maui.

Considerable progress had been made in the development of an oil spray to which synthetic toxicants were added when DDT was first received and included in the tests which were then being conducted at Waiahole. The results showed DDT to be superior to anything studied heretofore.

In this study various amounts of a 20 per cent mixture of DDT<sup>3</sup> were added to a commercial white oil emulsion spray used at a strength of 1:80. The kill of nymphs ranged from 19.2 per cent with DDT 1:800 (3.3 ounces of the 20 per cent concentrate per 100 gallons) to 94.3 per cent with DDT 1:200 (13.4 ounces of the 20 per cent concentrate per 100 gallons). The first mixture represents a concentration of 0.7 ounces of actual DDT per 100 gallons and the second a concentration of 2.7 ounces of DDT per 100 gallons.

In a second study, three replications of each of the following mixtures were studied: white oil emulsion 1:80 plus DDT (20 per cent strength) 1:200 or a concentration of active ingredient of 2.7 ounces per 100 gallons, and oil emulsion 1:60 plus DDT (20 per cent strength) 1:200. Counts made nine days after application indicated a control of 96.4 per cent with the former mixture and a control of 97.9 per cent with the latter.

In a study of DDT applied as a dust<sup>4</sup> and as a spray,<sup>5</sup> without inclusion of oil, it has been found that DDT used in these ways is capable of killing adult white flies and all stages of nymphs; eggs were not killed, while some pupae were killed and others were not. Young leaves free of white fly infestation at the time of application of the DDT have been kept completely free of adults for four days and almost completely free for eight days by a 2 per cent dust. A 1 per cent dust kept clean leaves almost free from infestation for eight days; a spray of 1 pound active ingredient per 100 gallons kept clean leaves almost completely free for six days.

Adults present to the extent of 100 or more per leaflet at the time of application of a 2 per cent dust started falling in a few minutes. In 10 minutes the leaves were almost free. In 37 minutes a total of

<sup>3</sup> Gesarol AKD 20 Spray containing 20 per cent active ingredient and wetting and spreading agents. This form of DDT was apparently not the best for inclusion with the oil emulsion for a scum rose to the top of the spray.

<sup>4</sup> Gesarol AX (3 per cent) dust diluted with talc.

<sup>5</sup> Gesarol AKD spray containing 20 per cent active ingredient.

only six remained on nine leaflets. The effect of a 1 per cent dust was similar, though the action was initially somewhat slower. (Sprays apparently removed the adults mainly by mechanical action.) "Crawlers" hatching from eggs present at the time of application succumbed before becoming 2nd instar nymphs with a 2 and a 1 per cent dust and with a spray of 1 pound active ingredient per 100 gallons.

"Crawlers" and other young nymphs present at the time of application are all killed by a 2 per cent dust within four days, and, although somewhat more slowly, within eight days, by a 1 or a 0.5 per cent dust. Nymphs are all killed within six days by a 2 per cent dust. Data available on the effect of DDT on pupae are somewhat variable. They indicate that some pupae are controlled by DDT while others are not. Some batches of pupae were killed 100 per cent in six days by a dust with as low a concentration as 0.5 per cent and by a spray of 1 pound active ingredient per 100 gallons; on the other hand some batches were not controlled even by a 2 per cent dust. The reason for this variation in survival of pupae has not yet been determined. It would appear that age might be a factor.

Thus the evidence to date indicates that it may not be necessary to use oil for the control of white fly. Subsequent work will determine more conclusively the most satisfactory method of application.

#### CHINESE ROSE BEETLE, *Adoretus sinicus* Burmeister

Chinese rose beetle, *Adoretus sinicus* (Scarabaeidae) is the most important foliage-consuming insect of green bean. When the beetles are abundant, the leaves are skeletonized. The beetle is also a major insect of Maui red bean, eggplant, and roses, and at times, causes serious injury to Chinese cabbage, broccoli, litchi, corn, peanut, grapes, okra, dasheen, and soy bean. It has been present in Hawaii for at least 48 years.

Over 40 materials or mixtures had been studied in a search for an insecticide to control rose beetle. A cage method, especially devised for work with this insect, was used in these investigations. Toxicity is measured by the survival of a standard number of beetles introduced after materials under test have been applied to the plant, and also by comparative amounts of foliage consumed. The only material found to be highly toxic to rose beetle was acid lead arsenate. Since this chemical commonly causes foliage injury, it has not been recommended for general use on beans, and the search for a material toxic to the beetle without phytotoxic properties has been continued.

DDT was secured especially for trial against rose beetle. The results obtained have been outstanding. After the first night's ex-

posure, mortality was 10 per cent with acid lead arsenate 3 pounds per 100 gallons, 45 per cent with a spray of DDT containing  $\frac{1}{2}$  pound of active ingredient per 100 gallons, 65 per cent with a spray of 1 pound active ingredient per 100 gallons, and 82 per cent with a 3 per cent DDT dust. One hundred per cent mortality was secured in three days with the 3 per cent dust, in four days with a spray of 1 pound per 100 gallons, and in eight days with a spray of  $\frac{1}{2}$  pound per 100 gallons. With a spray of acid lead arsenate 3 pounds per 100 gallons, 10 per cent of the beetles were still alive at the end of eight days. Later results indicated that a 2 per cent dust is even more toxic than a 3 per cent dust, and a 1 per cent dust is nearly as toxic as a 3 per cent dust. The results indicate that DDT applied as a spray and apparently acting in the main as a stomach poison is more than eight times as toxic to the beetle as acid lead arsenate.

After exposure of one night, mortality with a spray containing  $\frac{1}{8}$  pound of active ingredient per 100 gallons was twice as great as that secured with a spray of acid lead arsenate of strength 4 pounds per 100 gallons. Thus in the initial stages of the test, DDT was over 32 times as toxic as acid lead arsenate.

The early result with the dusts suggested that the beetles succumb with practically no consumption of the dusted foliage. Moreover, many of the beetles confined with a dusted plant are unable to crawl into the soil after they have been on the plant. This observation has been studied further by introducing beetles into an otherwise empty cage dusted with a 2 per cent dust of DDT.

Fifteen out of 36 beetles (42 per cent) confined overnight were dead the following morning. Those still alive were placed in a clean cage with a clean plant for food. All were dead after eight nights and practically none of the foliage of the clean plant had been consumed. A similar group of beetles subjected to 33 $\frac{1}{3}$  per cent lead arsenate under similar conditions was affected to a negligible extent; after one night one beetle (3 per cent) was dead; after eight nights only five were dead, whereas all were dead after exposure to the DDT dust for a single night. Both these sets of observations suggest that death can follow if the beetles merely walk over a dusted surface.

Studies on the phytotoxicity of DDT in the field have indicated no foliage injury and no reduction of yield from 1 and 2 per cent DDT dust, or from DDT sprays of 2 pounds per 100 gallons and 1 pound per 100 gallons. On the other hand, under some conditions a 3 per cent dust has caused foliage injury. The toxicity studies indicate, however, that 3 per cent dust is stronger than necessary to effect complete and rapid control. Although infestation by rose beetles was low when the studies on phytotoxicity were conducted an increase in yield was secured in the plots treated with DDT.

MELON FLY, *Dacus cucurbitae* Coq.

Melon fly has been present in Hawaii since before 1898 (1). It is a major pest of cucurbits and tomato, and at times, a pest of green bean. To date it has defied control by measures other than cultural control. The most toxic material discovered was tartar emetic, the toxicity of which has been worked out by entomologists of the fruit fly laboratory of the United States Bureau of Entomology and Plant Quarantine. A bait spray of 2 to 4 pounds per 100 gallons effects a kill of 50 per cent of the flies in an average time of 47 hours and a kill of 100 per cent in an average time of 96 hours. Flies which have partaken of tartar emetic are stimulated to early oviposition before they die. Thus tartar emetic is not an ideal material for controlling melon fly, and, in field studies has yielded results of so variable a nature as to prevent its being recommended as a general control measure.

The early test in which DDT was studied as a bait spray by the same method as that used for tartar emetic<sup>6</sup> indicated that it was unsatisfactory; the kill was much slower than with tartar emetic. In observations on DDT for the control of Chinese rose beetle, it was found that beetles walking over dusted leaves apparently succumbed without consuming dusted foliage. This suggested a trial of DDT dust for melon fly control. The initial studies in which the dust was applied to tomato and cucumber plants were not satisfactory since the flies, as a result of positive phototropic responses, congregated on the cages and spent little time on the dusted plants. Results from one of these tests, however, were such as to indicate that the dusts had promise if a satisfactory technique could be devised to demonstrate their effectiveness.

Two different procedures, both of which have proved satisfactory, have been used. In the first, the toxicity of DDT to the flies was measured; in the second, the ability of DDT to protect susceptible fruits was demonstrated. In the first procedure the inside of empty cages was dusted with the DDT dust. Then food and water were introduced followed by the flies. Six replicated tests, each involving 50 flies, were carried out in the insectary at different times with flies from different batches. Flies confined in cages dusted with 1 or 2 per cent DDT dusts started to fall in 15 minutes; 50 per cent were down in less than 2 hours; and all were down in 3 hours. With a 2 per cent dust, the first death occurred 6 hours after the introduction of the flies; all were dead in 24 hours. With a 1 per cent dust all were dead in 32 hours.

For comparison with DDT, nicotine and rotenone have been studied by the same method as that used for DDT dusts. Flies have been subjected to 3 and 4 per cent nicotine dusts and to rotenone dusts of 0.5 and 1 per cent concentration. Flies that walked over

<sup>6</sup>This method is described by Plummer (8).



a surface dusted with nicotine dust dropped rapidly but revived; flies that walked over a surface dusted with rotenone were apparently affected to a slight extent but were not killed. Flies which fall as a result of DDT do not revive when removed to a clean cage. Thus flies are put out of action at the time at which they fall, namely in from 15 minutes to 3 hours.

In the second procedure young cucumbers, approximately half-grown, were dusted with 2 per cent DDT dust and confined with 50 flies of approximately equal numbers of males and females. The undusted fruits yielded 32 larvae. The dusted fruits yielded none. Thus DDT is apparently capable of protecting fruits from oviposition.

It is apparent that DDT dusts are yielding toxicity results superior to those secured heretofore with tartar emetic. It also appears that if the normal place of oviposition is covered with a film of dust, oviposition is apparently prevented. The promising results secured to date in the cage tests are being applied to field studies. Such results as have been secured to date from preliminary studies in the field are gratifying, and hold out promise of ultimate success.

#### TOMATO BUG, *Cyrtopeltis varians* Distant

Tomato bug, which causes blossom shedding, has been in Hawaii since 1924—a comparatively short period of years. It is an insect of the low elevations and especially of the summer months. During the last two or three years it has assumed much greater importance, and must be ranked as a major insect, for, with the introduction of the variety Bounty which is suitable to low elevation conditions, tomato production has increased to a considerable extent under the conditions which are favorable to the bug.

Pyrethrum dust containing 2 per cent pyrethrins, rotenone dust 0.5 to 1.0 per cent, nicotine dust carrying 3.8 to 4 per cent nicotine, and lethane have been found to control tomato bug. Because of the present lack of pyrethrum and rotenone and the risk of foliage injury with lethane, the brunt of control has so far been carried by nicotine.

For effective control of tomato bug by these contact insecticides, applications are needed at as short an interval as five days during the period of flowering and fruit setting.

We have found that DDT dusts of 1 and 2 per cent concentration and a spray of 1 pound per 100 gallons, will control tomato bug satisfactorily. Moreover, the data so far secured indicate that DDT has the following advantages over the insecticides used to date: (1) the time during which the plants are protected is greater than the time of protection with the other insecticides studied to date;

(2) a build up of nymphal population is largely prevented because the eggs are prevented from hatching or the nymphs succumb soon after hatching.

#### CORN EARWORM, *Heliothis armigera* (Hübner)

Corn earworm is a major insect of tomato and is the most widespread tomato-attacking insect in Hawaii. In recent years infestation has become so common that successful tomato production requires regular applications of a suitable insecticide. Cryolite has been found to be a suitable insecticide which controls many other insects of tomato besides corn earworms. In our studies on DDT dusts applied to tomato, we have observed that applications of cryolite for control of corn earworm were not necessary when DDT was applied. These observations are in line with those already reported by Johnson (5) who has demonstrated that a 1 per cent dust of DDT was as effective as undiluted calcium arsenate and a 3 per cent dust was significantly more effective.

#### DISCUSSION

The evidence to date indicates that greenhouse white fly and Chinese rose beetle, the two most important insects of green bean not yet satisfactorily controlled, are controlled by a dust of 2 per cent strength. A 3 per cent dust, however, is detrimental to bean plants under some conditions, and further work is necessary on the effect of DDT on the plant and on other bean insects.

On tomato, the prospects are bright for controlling the three most important insect pests and several others with the one material—DDT. Studies are also in progress on some of the other insects of tomato.

In studies to date on cabbage, it has been found that a 1 per cent dust of DDT controls cabbage webworm as efficiently as a 50 per cent cryolite dust.

The conclusion has been reached that DDT is a remarkable insecticide with great potentialities for the control of many agricultural insects in Hawaii; some of these are insects, capable of devastating injury, which have hitherto defied control. However, it must be demonstrated that the strengths of insecticide necessary for the control of the respective insects are not detrimental to the crop plants. Work is also necessary to determine the best methods of applying DDT, the optimum concentration and time interval for applications, the range of concentration safe for use on various crop plants, and the compatibility of DDT with other materials such as fungicides. Practical use of DDT on vegetable crops is also dependent on work which will be done elsewhere on the toxicity of

DDT to human beings and also on a determination of the safe tolerance of DDT on food crops.

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## Notes on Some Hawaiian Insects

By N. L. H. KRAUSS

Board of Agriculture and Forestry

(Presented at the meeting of July 10, 1944)

A LIST is here given of some of the insects recently collected by the writer on various islands of the Hawaiian group. Species recorded for the first time from a particular island are marked with an asterisk. I wish to thank the following persons who have kindly identified most of the specimens: O. H. Swezey (Orthoptera, Delphacidae, Cixiidae, Dermaptera, Coleoptera and Lepidoptera), F. X. Williams (Diptera and Hymenoptera), E. O. Essig (Aphididae), H. Morrison (Coccidae), C. P. Alexander (Diptera: Tipulidae) and L. M. Russell (Aleyrodidae).

## Orthoptera

## BLATTIDAE

\**Blattella germanica* (L.), Nawiliwili, Kauai, Jan. 18, 1944 (1); Ahukini, Kauai, Jan. 19 (3).

\**Euthyrrhapha pacifica* (Coq.), Holualoa, Hawaii, April 23, 1944 (1).

\**Graptoblatta notulata* (Stål), Lihue, Kauai, Jan. 9, 11, 14 and 16 (4); Anahola, Kauai, Jan. 20 (1).

\**Pycnoscelus surinamensis* (L.), Waimea, Kauai, Jan. 6, 1944 (2).

## LOCUSTIDAE

*Atractomorpha ambigua* Bol., Holualoa, Hawaii, April 23, 1944 (1).

## TETTIGONIIDAE

*Holochlora japonica* (Brun.), Moloaa, Kauai, Jan. 7, 1944 (1 nymph).

## GRYLLIDAE

*Cycloptiloides americanus* (Sauss.), Waimea, Kauai, Jan. 6, 1944 (3).

\**Cycloptilum bimaculatum* (Shiraki), Anahola, Kauai, Jan. 20, 1944 (1).

*Leptogryllus kauaiensis* Perk., Kokee, Kauai, Jan. 8, 1944 (1); Waipahee, Kauai, Jan. 13 (1).

\**Myrmecophila quadrispina* Perk., near Makaweli, Kauai, Jan. 10, 1944 (3).

## Isoptera

*Kaloterms immigrans* Snyder, Kilohana Crater road, Kauai, Jan. 21, 1944, in log fence post (6).

## Neuroptera

\**Symphorobius barberi* Banks, Wailuku, Maui, June 6, 1943. Determined by E. C. Zimmerman.

## Corrodentia

*Caecilius* sp., Kaunakakai, Molokai, Oct. 13, 1943, leaves *Citrus* sp. Determined by H. K. Townes.

\**Echmepteryx marmorata* Banks, Hana, Maui, June 8, 1943. Determined by E. C. Zimmerman.

*Ectopsocus* sp., Mapulehu, Molokai, Oct. 11, 1943, leaves *Morinda citrifolia* L. Determined by H. K. Townes.

## Homoptera

### CERCOPIDAE

*Philaenus spumarius* (L.), numerous specimens on various plants, Kilauea area, Hawaii, April 1944.

### CICADELLIDAE

*Empoasca solana* De L., Kaunakakai, Molokai, Oct. 9, 1943, leaves *Amaranthus spinosus* L. and *Ricinus communis* L. Determined by R. H. Beamer.

\**Opsius stactogalus* (Amyot), Kapaa, Kauai, Jan. 7, 1944, *Tamarix* sp. (4 adults, 2 nymphs); Wailua, Kauai, Jan. 11, *Tamarix* sp. (2 adults).

### DELPHACIDAE

*Ilburnia koae* (Kirk.), Kokee, Kauai, Jan. 8, 1944 (2).

### CIXIIDAE

\**Iolania perkinsi* Kirk., Hanahanapuni, near Kapaia, Kauai, Jan. 20, 1944 (1).

### APHIDIDAE

\**Amphorophora sonchi* (Oestl.), Kilauea, Kauai, Jan. 7, 1944, leaves and buds *Sonchus oleraceus* L.; Holualoa, Hawaii, April 22, 1944, leaves *S. oleraceus*.

\**Aphis ferruginea-striata* Essig, Half Way Bridge, Lihue—Kalaheo road, Kauai, Jan. 18, 1944, carrot stems.

*Aphis gossypii* Glover, Kauai (Jan. 1944): Lihue, near Makaweli, Mana, Hanapepe Valley and Half Way Bridge. Hawaii (April 1944): Hilo, Kilauea and Holualoa. On the following hosts: leaves and stems of chili pepper; leaves of *Hibiscus tiliaceus* L.; *Hibiscus sabdariffa* L.; leaves and buds of *Senecio* sp.; leaves and stems of *Indigofera anil* L.; *Commelina nudiflora* L.; tomato leaves; leaves of "shirona" (*Brassica* sp.); *Gnaphalium* sp.; leaves of *Arctium lappa* L.; leaves of azalea; leaves of *Psidium guajava* L. and leaves of zucchini.

*Aphis helichrysi* Kalt., Kokee, Kauai, Jan. 8, 1944, leaves *Erigeron canadensis* L.

*Aphis maidis* Fitch, Waimea, Kauai, Jan. 6, 1944; Kokee, Kauai, Jan. 8; Kekaha, Kauai, Jan. 12, *Coix lacrymae-jobi* L.

\**Aphis medicaginis* Koch, Waimea, Kauai, Jan. 6, 1944, lima bean and leaves of *Mirabilis jalapa* L.; Wailua, Kauai, Jan. 21, leaves *Crotalaria* sp.; near Makaweli, Kauai, Jan. 10, leaves and stems *Indigofera anil* L.; Anahola, Kauai, Jan. 20, *Portulaca oleracea* L.

\**Aphis middletonii* Thos., Hanapepe Valley, Kauai, Jan. 14, 1944, roots *Bidens pilosa* L. and leaves and roots *Emilia* sp.

*Aphis rumicis* L., Honolulu, Oahu, March 22, 1943, *Bougainvillea spectabilis* Willd.; Lihue, Kauai, Jan. 9, 1944, leaves and stem chili pepper; Hanapepe Valley, Kauai, Jan. 14; Half Way Bridge, Kauai, Jan. 18, leaves *Arctium lappa* L.

*Aphis tavaresi* Del Guer., Wailua, Kauai, Jan. 21, 1944, young leaves *Citrus* sp.; Hilo, Hawaii, April 11, 1944, azalea leaves; Hilo, April 29, leaves navel orange; Waipio Valley, Hawaii, April 27, leaves *Citrus* sp.

*Brevicoryne brassicae* (L.), Kilauea, Hawaii, April 16, 1944, daikon leaves (*Raphanus sativus longipinnatus* Bail.); Honokaa, Hawaii, April 26, stem cruciferous plant.

\**Capitophorus braggii* (Gill.), Kilauea, Hawaii, April 16, 1944, artichoke leaves.

*Cavariella capreae* (Fabr.), Waimea, Hawaii, April 26, 1944, celery leaves.

*Macrosiphum rosae* (L.), Kilauea, Hawaii, April 16 and 18, 1944, rose leaves.

\**Macrosiphum rosaeifolium* Theob., Kokee, Kauai, Jan. 8, 1944, rose; Kekaha, Kauai, Jan. 12, rose leaves.

*Macrosiphum solanifolii* (Ashm.), Kilauea, Hawaii, April 16, 1944, lettuce and zucchini leaves; Waimea, Hawaii, April 26, celery and *Arctium lappa* L. leaves; Ahualoa, near Honokaa, Hawaii, April 28, Easter lily leaves.

\**Micromyzus formosanus* (Takah.), Lihue, Kauai, Jan. 17, 1944, leaves *Allium fistulosum* L.; Ahualoa, near Honokaa, Hawaii, April 28, 1944, green onion leaves.

\**Myzus circumflexus* (Buck.), Hualalai, Hawaii, April 20, 1944; Waimea, Hawaii, April 26, leaves *Arctium lappa* L.; Pepeekeo forest reserve, Hawaii, May 1, leaves *Vaccinium* sp.

\**Myzus ornatus* Laing, 6300 ft., Hualalai, Hawaii, April 20, 1944, unidentified composite plant.

\**Myzus persicae* (Sulz.), Kauai (Jan. 1944): Lihue, near Wailua, Mana, Half Way Bridge and Anahola. Hawaii (April 1944): Kilauea and Ahualoa, near Honokaa. On the following hosts: cabbage leaves, *Brassica* sp. leaves, potato leaves, cauliflower leaves, "shirona" (*Brassica* sp.) leaves, daikon leaves, carrot leaves, broccoli leaves, lettuce leaves and Easter lily leaves.

\**Neophyllaphis araucariae* Takah., Lawai, Kauai, Jan. 6, 1944, leaves *Araucaria excelsa* R. Br.

\**Pentalonia nigronervosa* Coq., Half Way Bridge, Kauai, Jan. 18, 1944, stems upland taro (*Colocasia esculenta* Schott); Hilo, Hawaii, April 11, 1944, flowers *Alpinia purpurata* (Vieill.) Schum.

\**Rhopalosiphum nymphaeae* L., Lihue, Kauai, Jan. 11, 1944, leaves *Ipomoea reptans* (L.) Poir.; Hilo, Hawaii, May 3, 1944, leaves and stems *Monochoria hastata* (L.) Solms.

\**Rhopalosiphum pseudobrassicae* (Davis), Mana, Kauai, Jan. 12, 1944, leaves "shirona" (*Brassica* sp.).

*Toxoptera aurantii* (Fonscolomb), Lihue, \*Kauai, Jan. 19, 1944, young leaves pomelo (*Citrus maxima* Merr.); Kilauea, Hawaii, April 14, 1944, unidentified plant, leaves of *Vaccinium* sp. and camellia; Kilauea, April 18, leaves *Myrsine lessertiana* A. DC.; Hualalai, Hawaii, April 20; Holualoa, Hawaii, April 22, general sweeping.

#### ALEYRODIDAE

\**Dialeurodes kirkaldyi* (Kot.), Honiuliwai, Molokai, Oct. 11, 1943, leaves *Jasminum sambac* Sol.; Mapulehu, Molokai, Oct. 11, and Halawa Valley, Molokai, Oct. 12, leaves *Morinda citrifolia* L.

\**Pealius hibisci* (Kot.), Kaunakakai, Molokai, Oct. 10, 1943, leaves *Hibiscus rosa-sinensis* L.

*Trialeurodes vaporariorum* (Westw.), Kamalo, Molokai, Oct. 11, 1943, leaves *Nicotiana glauca* Grah.

#### COCCIDAE

*Ceroplastes rubens* (Mask.), Halawa Valley, Molokai, May 30, 1943.

*Chrysomphalus aonidum* (L.), Kaunakakai, Molokai, May 29, 1943, coconut leaves; Kaunakakai, May 31, *Aleurites moluccana* (L.) leaves; Ualapue, Molokai, Oct. 11, leaves *Pandanus* sp.

\**Coccus viridis* (Green), Halawa Valley, Molokai, June 6, 1943; Mapulehu, Molokai, Oct. 11, leaves *Morinda citrifolia* L.

*Icerya purchasi* Mask., Kawela, Molokai, June 2, 1943; Pukoo, Molokai, Oct. 12, *Acacia* sp.; Hanapepe Valley, Kauai, Jan. 14, 1944 (1 male).

\**Ischnaspis longirostris* (Sign.), Ualapue, Molokai, Oct. 11, 1943, *Pandanus* sp. leaves.

*Orthezia insignis* Doug., Wailuku, Maui, June 6, 1943; Waipio, Hawaii, April 27, 1944, *Salvia* sp.

*Phenacaspis* sp., presumably *eugeniae* var. *sandwicensis* Full., Kaunakakai, Molokai, June 5, 1943, leaves *Mangifera indica* L.; Ualapue, Molokai, Oct. 11, same host.

\**Phenacoccus gossypii* Towns. & Kll., Mapulehu, Molokai, Oct. 12, 1943, Cayenne pepper (*Capsicum frutescens longum* Bail.).

*Pinnaspis* sp., Kaunakakai, Molokai, Oct. 13, 1943, *Amaranthus* sp.; Ualapue, Molokai, Oct. 11, leaves *Pandanus* sp.; Kainalu, Molokai, Oct. 12, *Abutilon molle* Sweet.

*Pseudococcus adonidum* (L.), Honolulu, Oahu, Feb. 3, 1943, fruiting panicle of *Cordyline terminalis* Kunth.

*Pseudococcus brevipes* (Ckll.), Honolulu, Oahu, March 28, 1943, roots *Chloris inflata* Link; Pukoo, Molokai, Oct. 12, 1943, celery roots; Mapulehu, Molokai, Oct. 12, grass roots (specimens of the last collection come within the limits of *P. brevipes* as currently recognized but are not characteristic).

*Pseudococcus* sp., *citri* complex, probably *kraunthiae* (Kuw.), Kamalo, Molokai, Oct. 11, 1943, tobacco stems and *Nicotiana glauca* Grah. leaves; Ualapue, Molokai, Oct. 11, *Mangifera indica* L. fruit.

*Pseudococcus giffardi* (Ehrh.), Manoa, Oahu, Aug. 15, 1943, *Pandanus* sp. leaves.

*Pseudococcus* (*Ferrisia*) *virgatus* (Ckll.), Honolulu, Oahu, Sept. 27, 1943, leaves ornamental taro (*Alocasia* sp.); Kaunakakai, Molokai, Oct. 12, same host.

*Pulvinaria psidii* Mask., Mapulehu, Molokai, Oct. 11, 1943, *Morinda citrifolia* L.

*Saissetia nigra* (Nietn.), Moomomi, Molokai, June 1, 1943, *Emex spinosa* Campd.; Kainalu, Molokai, Oct. 12, *Abutilon molle* Sweet.

## Dermaptera

*Anisolabis eteronoma* Bor., Kokee, \*Kauai, Jan. 8, 1944 (1); Lihue, Kauai, Jan. 9 (1); Hanamaulu, Kauai, Jan. 11 (1 nymph); Waimea, Hawaii, April 26, 1944 (2).

\**Chelisoches morio* (Fabr.), Lihue-Kalaheo road, Kauai, Jan. 6, 1944 (2); Nawiliwili, Kauai, Jan. 18 (2).

## Coleoptera

### HYDROPHILIDAE

\**Cercyon quisquilius* (L.), Glenwood, Hawaii, April 30, 1944 (1).

### CORYLOPHIDAE

\**Anisomeristes basalis* (Sharp), Moloaa, Kauai, Jan. 7, 1944 (1); Lihue, Kauai, Jan. 9 (1).

### COCCINELLIDAE

*Coelophora inaequalis* (Fabr.), Lihue, Kauai, Jan. 9, 1944 (1).  
\**Coelophora pupillata* (Schön.), Hilo, Hawaii, April 29, 1944 (1).

*Cryptolaemus montrouzieri* Muls., Lihue-Kalaheo road, Kauai, Jan. 6, 1944 (2); Hanamaulu, Kauai, Jan. 11 (3).



\**Curinus coeruleus* (Muls.), Holualoa, Hawaii, April 23, 1944 (3); Kealahkekua, Hawaii, April 24 (2).

\**Hyperaspis jocosa* (Muls.), Holualoa, Hawaii, April 22, 1944 (1) and April 23 (4); Kealahkekua, Hawaii, April 24 (1).

\**Nephus bilucernarius* (Muls.), Hanapepe Valley, Kauai, Jan. 14, 1944 (5).

\**Orcus chalybeus* Boisd., Kokee, Kauai, Jan. 8, 1944 (1).

\**Pullus kinbergi* (Boh.), Waimea Valley, Kauai, Jan. 6, 1944 (1); Mana, Kauai, Jan. 12 (3); Wailua, Kauai, Jan. 21 (1); Hilo, Hawaii, May 3, 1944 (3).

*Rodolia cardinalis* (Muls.), Lihue, \*Kauai, Jan. 10, 1944 (1); Polihale, Kauai, Jan. 12 (1); Wailua, Kauai, Jan. 21 (1); Holualoa, Hawaii, April 22, 1944 (1); Malama Ki forest reserve, Puna, Hawaii, May 2 (1).

\**Scymnus (Pullus) uncinatus* Sic., Holualoa, Hawaii, April 22, 1944 (6) and April 23 (2).

#### CUCUJIDAE

*Cryptamorpha desjardinsi* (Guer.), Kokee, Kauai, Jan. 8, 1944 (2); Lihue, Kauai, Jan. 9 (1); Hanamaulu, Kauai, Jan. 11 (1); Half Way Bridge, Kauai, Jan. 18 (1); Kilauea, Hawaii, April 14, 1944, dead *Cibotium* sp. (1); Kilauea, April 18 (6); Waimea, Hawaii, April 26 (1); Waipio, Hawaii, April 27 (1).

\**Laemophloeus minutus* (Oliv.), Mana, Kauai, Jan. 12, 1944 (1).

\**Nausibius dentatus* (Marsh.), Lihue, Kauai, Jan. 9, 1944 (2).

*Psammoechus insularis* (Sharp), Lihue, Kauai, Jan. 9, 1944 (5), Jan. 10 (1), Jan. 11 (2); Hanamaulu, Kauai, Jan. 11 (1); Waipio, \*Hawaii, April 27, 1944 (1).

#### MYCETOPHAGIDAE

*Litargus vestitus* Sharp, Molooa, \*Kauai, Jan. 7, 1944 (5); Lihue, Kauai, Jan. 9 (1); Hanapepe Valley, Kauai, Jan. 14 (9); Holualoa, Hawaii, April 22, 1944 (1).

#### DERMESTIDAE

\**Eucnocerus anthrenoides* Sharp, Wailua, Kauai, Jan. 21, 1944 (1).

#### NTIDULIDAE

*Carpophilus dimidiatus* (Fabr.), Waimea, \*Kauai, Jan. 6, 1944 (7); Waimea Valley, Kauai, Jan. 6 (13); Lawai beach, Kauai, Jan. 14 (9); Holualoa, Hawaii, April 23, 1944 (4).

\**Carpophilus humeralis* (Fabr.), Lihue-Kalaheo road, Kauai, Jan. 6, 1944 (9); Waimea, Kauai, Jan. 6 (2); Haena, Kauai, Jan. 7 (2); Nawiliwili, Kauai, Jan. 18 (1); Kailua, Hawaii, April 23, 1944 (1); Kaumana, Hilo, Hawaii, May 4 (2).

\**Haptoncus ocularis* (Fairm.), Haena, Kauai, Jan. 7, 1944 (3).

## MALACODERMIDAE

\**Caccodes debilis* Sharp, Hanapepe Valley, Kauai, Jan. 14, 1944 (2).

## BOSTRICHIDAE

\**Dinoderus minutus* (Fabr.), Molokai, Kauai, Jan. 7, 1944 (1).

\**Xylopsocus castanoptera* (Fairm.), Kealahou, Hawaii, April 24, 1944 (1).

## SCARABAEIDAE

*Saprosites pygmaeus* Har., Waipahee, Kauai, Jan. 13, 1944 (1).

## CERAMBYCIDAE

\**Cyllene crinicornis* (Chevr.), Mana, Kauai, Jan. 12, 1944 (1); Nawiliwili, Kauai, Jan. 17 (1).

*Sybra alternans* Wied., Lihue, \*Kauai, Jan. 9, 1944 (5), Jan. 16 (1); Kailua, Hawaii, April 23, 1944 (2); Malama Ki forest reserve, Puna, Hawaii, May 2 (1).

## CHRYSOMELIDAE

*Epitrix parvula* (Fabr.), Kokee, Kauai, Jan. 8, 1944, *Physalis peruviana* L. (6); Kilauea, \*Hawaii, April 18, 1944 (2); Holualoa, Hawaii, April 22 (1).

## BRUCHIDAE

\**Bruchus chinensis* (L.), Hanapepe Valley, Kauai, Jan. 14, 1944 (2).

\**Bruchus prosopis* LeC., Polihale, Kauai, Jan. 12, 1944 (1); Kailua, Hawaii, April 23, 1944 (3).

\**Bruchus sallaei* Sharp, Waimea, Kauai, Jan. 6, 1944 (1); Mana, Kauai, Jan. 12 (3); Polihale, Kauai, Jan. 12 (1); Kailua, Hawaii, April 23, 1944 (1).

## TENEBRIONIDAE

\**Alphitobius laevigatus* (Fabr.), Kailua, Hawaii, April 23, 1944 (5).

\**Epitragus diremptus* Karsch, Kailua, Hawaii, April 23, 1944 (1).

## XYLOPHILIDAE

\**Xylophilus* sp., Lihue, Kauai, Jan. 16, 1944 (1); Nawiliwili, Kauai, Jan. 17 (3).

## Lepidoptera

## NYMPHALIDAE

*Vanessa cardui* L., Hilo, Hawaii, April 12, 1944, larvae numerous on leaves of *Artemisia vulgaris* L., 1 reared; Waimea, Hawaii, April 26, 1 reared from leaves of *Arctium lappa* L.

## PYRAUSTIDAE

\**Nymphula oblitalis* (Walk.), Lihue, Kauai, Jan. 10, 1944, beside lily pond (1).

## Diptera

## TIPULIDAE

\**Limonia (Dicranomyia) casei* Alex., Olinda, Maui, June 12, 1943.

*Limonia (Dicranomyia) hawaiiensis* (Grim.), Olinda, Maui, June 12, 1943.

*Limonia (Dicranomyia) jacobus* (Alex.), Olinda, Maui, June 12, 1943.

*Limonia (Dicranomyia) stygipennis* (Alex.), Olinda, Maui, June 12, 1943.

*Limonia (Dicranomyia) variabilis* (Grim.), Olinda, Maui, June 12, 1943.

## CULICIDAE

*Aedes albopictus* (Skuse), Ahukini, Kauai, Jan. 19, 1944 (4).

## STRATIOMYIIDAE

\**Evaza javanensis* Meig., Lihue, Kauai, Jan. 9, 1944 (8).

*Microchrysa hovas* (Big.), Mana, Kauai, Jan. 12, 1944 (1); Anahola, Kauai, Jan. 20 (1); Hanahanapuni, near Kapaia, Kauai, Jan. 20 (1).

## DOLICHOPODIDAE

*Chrysosoma fraternum* Van Duzee, Kekaha, Kauai, Jan. 5, 1944 (3); Waimea, Kauai, Jan. 6 (4); Mana, Kauai, Jan. 12 (2); Ahukini, Kauai, Jan. 19 (1); Anahola, Kauai, Jan. 20 (3); Wailua, Kauai, Jan. 21 (2).

\**Chrysosoma pallidicornis* (Grim.), Haena, Kauai, Jan. 7, 1944 (1).

## SYRPHIDAE

*Eumerus marginatus* Grim., Holualoa, Hawaii, April 22, 1944 (1).

## TACHINIDAE

\**Eucelatoria armigera* (Coq.), Lihue, Kauai, Jan. 11, 1944 (1); Waipahee, Kauai, Jan. 13 (1).

## SARCOPHAGIDAE

\**Helicobia helicis* (Towns.), Lihue, Kauai, Jan. 9, 1944 (7); Waipahee, Kauai, Jan. 13 (1); Wailua, Kauai, Jan. 13 (1); Wailua, Kauai, Jan. 21 (1).

## CALLIPHORIDAE

*Stomorphina pleuralis* (Thoms.), Lihue, Kauai, Jan. 11, 1944 (1); Hanamaulu, Kauai, Jan. 11 (2); Wailua, Kauai, Jan. 21 (7); Waimea, Hawaii, April 26, 1944 (2).

## ANTHOMYIIDAE

*Atherigona excisa trilineata* Stein, Waimea, Kauai, Jan. 6, 1944 (1); Moloaa, Kauai, Jan. 7 (1); Lihue, Kauai, Jan. 9, 1944 (4), Jan. 11 (1); Hanamaulu, Kauai, Jan. 11 (9); Waipahee, Kauai,

Jan. 13 (1) ; Anahola, Kauai, Jan. 20 (1) ; Wailua, Kauai, Jan. 21 (1).

#### ORTALIDAE

*Chrysomya aenea* (Fabr.), Lihue, Kauai, Jan. 9, 1944 (2), Jan. 10 (1) ; Hanamaulu, Kauai, Jan. 11 (2).

\**Notogramma stigma* (Fabr.), Waimea, Kauai, Jan. 6, 1944 (12) ; near Makaweli, Kauai, Jan. 10 (1).

#### EPHYDRIDAE

*Brachydeutera hebes* Cress., Polihale, Kauai, Jan. 12 (1).

\**Mosillus* sp., Hanamaulu, Kauai, Jan. 11, 1944 (3) ; the first record of this genus from the Hawaiian Islands.

\**Scatella warreni* Cress., Waipahee, Kauai, Jan. 13, 1944 (1).

#### AGROMYZIDAE

*Lirionomyza pusilla* (Meig.), Anahola, Kauai, Jan. 20, 1944 (1) ; Wailua, Kauai, Jan. 21 (1).

#### MILICHIIDAE

\**Desmometopa m-nigrum* Zett., Mana, Kauai, Jan. 12, 1944 (1).

\**Milichiella circularis* Ald., Hanamaulu, Kauai, Jan. 11, 1944 (1).  
*Milichiella lacteipennis* (Loew), Hanamaulu, Kauai, Jan. 11, 1944 (2).

#### CHLOROPIDAE

\**Prohippaelates pallidus* (Loew), Anahola, Kauai, Jan. 20, 1944 (2).

#### CARNIDAE

\**Rhodesiella tarsalis* Adams, Waimea, Kauai, Jan. 6, 1944 (2) ; Lihue, Kauai, Jan. 9 (2), Jan. 16 (1) ; Mana, Kauai, Jan. 12 (1) ; Wailua, Kauai, Jan. 21 (2).

### Hymenoptera

#### FORMICIDAE

\**Camponotus variegatus hawaiiensis* For., Waimea Valley, Kauai, Jan. 6, 1944 (8).

*Leptogenys falcigera insularis* Smith, Haena, Kauai, Jan. 7, 1944 (4) ; \*Waipio, Hawaii, April 27, 1944 (2).

*Solenopsis geminata rufa* (Jerd.), outskirts of Hilo, Hawaii, April 12, 1944, many on guava plant.

#### VESPIDAE

*Polistes macaensis* (Fabr.), Kailua, Hawaii, April 23, 1944 (1) ; Holualoa, Hawaii, April 23 (1).

#### LARRIDAE

*Motes (Notogonidea) subtessellata* (Sm.), Moloaa, Kauai, Jan. 7, 1944 (1).

\**Solierella rohweri* (Brid.), Mana, Kauai, Jan. 12, 1944 (1).



Collections of Thrips from Kauai and Hawaii<sup>1</sup>

By K. SAKIMURA

Pineapple Research Institute

and

N. L. H. KRAUSS

Board of Agriculture and Forestry<sup>2</sup>*(Presented at the meeting of December 11, 1944)*

ONE of the authors (NLHK) collected thrips on the island of Kauai during the period from January 6 to 20 in the midst of the rainy season, and on the island of Hawaii from April 11 to May 2, 1944 immediately after the rainy season; the other author (KS) examined the specimens.

Twenty-two lots of specimens involving 15 species were collected on Kauai at various localities from Haena to Mana along the coastal lowland and also at a high elevation at Kokee. The last previous collection had been made during the summer months of 1943 (11)<sup>3</sup> but the present winter collection brought different species to attention and nine heretofore unrecorded species were found. The known species now total 37 which is the largest number known from a single island except Oahu. Species marked with an asterisk are new records for Kauai. *Thrips nigropilosus* Uzel was inadvertently omitted from the previous list (11).

The collection from Hawaii consisted of 26 lots involving 14 species collected mostly from the native forests at elevations up to 6,500 ft. at Kilauea, Mt. Hualalai, and Waimea. The species found in these upper forest zones are very interesting as regards the number of indigenous *Isoneurothrips*. Some collections were also made at several localities of the cultivated coastal areas.

The island of Hawaii is the only island, except Lanai, from which no extensive thrips collection had been made since the days of Dr. Perkins, and very little was known of its thysanopterous fauna. Yet, owing to its comparatively undisturbed vegetation and high elevation, this island has long been thought to be a very rich collecting ground for indigenous species of thrips, and now the initial attempt has been made to explore this little-known island. However, casual collections and observations had already recorded 16 species

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<sup>2</sup>The authors wish to express appreciation to Miss M. C. Neal of the B. P. Bishop Museum for identifying some of the host plants and checking the botanical names used in the paper, and to Mr. Arthur Mitchell of the National Park Service, Kilauea, Hawaii for identifying some of the host plants.

<sup>3</sup>Figures in parentheses refer to literature cited at end of paper.

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prior to the present collection which added ten more species to the list. A complete list of species now known from the island of Hawaii is given at the end of the paper.

#### THRIPS FROM KAUAI

##### \**Organothrips bianchii* Hood

Lihue; Waimea: *Colocasia esculenta* (taro), petioles.

Moderate infestation was found at both of the commercial taro patches examined, which indicates that this species is as common on this unique host there as on the other Hawaiian islands. This is the first record reported from Kauai.

Recent observations on Oahu show that this species is always present on the wetland taros wherever they grow, in the lowland patches as well as among "wild" taro (aweu) growing along streams in the upper forests. However, the limited incidence observed shows that this species is not associated with the dryland taros, even when growing in a moist lower forest area. This may be due to little or no free water and slimy substance between the overlapping sinuses on the lower part of the petioles, or to the method of propagation of dryland taro which is unfavorable for dissemination of this insect. Dryland taro is propagated with a cormel or "oha" and not with a central bud cut or "huli", as is the case with wetland taro and it is on this central bud that the species feeds. Furthermore, this species has very little ability to fly. Another interesting point observed is that this species is quite specific in host preference. Many wild ape plants ([?] *Alocasia macrorrhiza*) examined in the forest area at Waikane did not show any sign of infestation in spite of the heavy infestation commonly present on "wild" taros growing together with ape. Ape plants growing in several gardens of the drier section of Honolulu also showed no infestation. Careful examinations at Waiau of large numbers of several other paddy plants with growing habits similar to those of wetland taro showed no infestation although these plants were growing together with heavily infested wetland taros. The plants examined were water hyacinth (*Eichhornia crassipes*), arrowhead (*Sagittaria* sp.), and calla lily (*Zantedeschia aethiopica*).

##### *Heliothrips haemorrhoidalis* (Bouché)

Kokee: *Pelea* sp. (alani), leaves.

Incidental specimens were found on this native tree, a new host record, in the wet forest.

##### \**Hercinothrips femoralis* (Reuter)

Lihue: *Emilia* sp. (pualele), leaves.

*Sonchus oleraceus* (sow thistle), leaves.

*Crinum* sp. (spider lily), flowers.

Moderate infestation was found on *Emilia* and *Sonchus* growing in open wasteland and incidental specimens were also found on *Crinum* flowers. These are further records of outdoor infestation and it is now certain that this species is one of the common outdoor thrips as well as a common feeder in greenhouses. This is the first record reported from Kauai and the latter two hosts are new. Incidentally, this species was recently found in unusual surroundings: a large colony of water hyacinth (*Eichhornia crassipes*), a new host record, at Waiau, Oahu was uniformly and moderately infested on its fleshy petioles or leaves near the water line. Evidently this species prefers moist surroundings.

#### **Chirothrips spiniceps** Hood

Half Way Bridge: corn, leaves.

Extremely small thrips populations were found in a large planting of young corn in fairly moist surroundings of this well forested area. Five different species were found among the eight specimens caught within the rolled heart leaves. A single specimen of this species was found on this new host plant.

#### **\*Anaphothrips (Chaetanaphothrips) sp.**

Half Way Bridge: corn, leaves.

This is the second species found on young corn; a single specimen was collected. This is a new species closely related to and often found together with *A. orchidii* (Moulton). Its description will be published elsewhere. Its distribution is not restricted to Kauai for several specimens have been previously collected from parsley, several gingers (*Alpinia purpurata*, *Hedychium flavum*, and *Zingiber Zerumbet*†), bougainvillea (*Bougainvillea spectabilis parviflora*), and ricegrass (*Paspalum orbiculare*), in moist surroundings near the lower forests on Oahu.

#### **\*Frankliniella flavens** Moulton

Half Way Bridge: corn, leaves.

This is the third species found on corn and two specimens were collected. Since 1927, when the type specimens were collected (2), this species has not been reported from any other island besides Oahu, so apparently this is a new record for Kauai. This species, essentially a grass thrips having a narrow host range, is always found in large numbers on corn, a preferred host, wherever it grows, and is a predominating thrips on this plant. This thrips breeds freely in the folds of rolled heart leaves of young plants as well as in the interspace, usually at the basal portion of the ear, between the overlapping husks of the young or mature ears. Thus,

†At the request of the senior author, the capitalization of botanical specific names in this paper follows the recommendation made in the International Rules of Botanical Nomenclature, 1935 [Ed.].



it is not uncommon to find a colony of this thrips on green corn in the market. It appears that moist surroundings, such as wet areas near the lower forests and well-irrigated or damp areas of the open lowlands, are the preferred habitat and that increase in populations occurs in the winter months. Collections, all during the winter, have been made at the following localities on Oahu: Waialae, upper Palolo Valley, Manoa Valley, Waiawa, Waipahu, Waipio Camp A, Wahiawa, Kaaawa, and Kahaluu. Milo (*Sorghum vulgare* var.) is another cultivated host plant, while panicum grass (*Panicum purpurascens*), on which the thrips populations are very much lower than those on corn, is the only alternative wild host yet known.

**Thrips hawaiiensis** (Morgan) and **T. hawaiiensis f. imitator** Pr.

Haena: *Hippobroma longiflora* (Star of Bethlehem), flowers.

Lihue: *Pandanus* sp. (lauhala), flowers.

*Crinum* sp. (spider lily), flowers.

Nawiliwili: *Crinum* sp. (spider lily), flowers.

This common flower thrips, a winter or wetland species, was found abundantly on Kauai. *Frankliniella* sp., a dryland flower thrips, which was found there abundantly in the summer months (11) was not found during this trip. On lauhala this species was associated with the predominating *Stulothrips trespinus* Moulton. Among 66 specimens examined, four had non-segmented, 27 had partially segmented, and 26 had fully segmented styles, but nine had anomalous antennae.

**Thrips saccharoni** Moulton

Half Way Bridge: corn, leaves.

This is the fourth species found on corn; three specimens were collected. One of them had typical coloration but the other two were quite different from the type which is "uniformly dark greyish brown, thorax sometimes a little lighter" (2). This atypical form is dark greyish brown on abdomen, but light brownish yellow with greyish tinge on head and thorax. The antennal coloration is different from the typical form. Segments I and II are light greyish brown being somewhat concolorous with head and lighter than those of the typical form; III is light yellow like the typical form; IV and V are light yellow on the basal half but light greyish brown on the apical half, whereas in the typical form IV is totally yellow; VI and VII are dark greyish brown being concolorous with abdomen except slightly lighter on the basal third of VI compared to the yellow of the basal half of VI in the typical form. Immaturity of specimens cannot account for these color variations, as the abnormality is specific for certain portions of the body only. Nine paratype specimens available in Honolulu were examined for this atypical form

but it was not found present. However, both forms are frequently mixed in a single colony, the atypical form usually in incidental number. The following data are available from the collections made on sugar cane on Oahu: 38 typical forms and three atypical at (wet) Pauoa Flat in May, 36 typical and two atypical at (dry) Kunia in May, and three typical and one atypical at (wet) upper Palolo Valley in August. This species prefers to feed within the rolled young leaves of cane or other hosts.

**Thrips tabaci** Lind.

Anahola: cabbage, leaves.

Wailua: broccoli, leaves.

cauliflower, leaves.

pea, leaves.

Medium to heavy infestations were found on these host plants. It is interesting to note that all these specimens were of the dark form which usually appears in the winter months or in the wetter districts of the Hawaiian Islands.

**\*Thrips (Isoneurothrips) williamsi** (Moulton)

Although this species was not collected during the present trip, a few specimens were identified from the lot collected on koa (*Acacia Koa*) flowers at the edge of Waimea Canyon during the previous trip in 1937 (8). For details, see page 328.

**Plesiothrips panicus** (Moulton)

Half Way Bridge: corn, leaves.

This is the fifth species found on corn; a single specimen was collected. The host is a new record for this species.

**\*Stulothrips trespinus** Moulton<sup>4</sup>

Lihue: *Pandanus* sp. (lauhala), male flowers.

A very heavy infestation was found on a tree growing in a yard. The type specimens of this Hawaiian species were collected on Oahu in 1930 (3) but this species has never been reported from any other island, and evidently this is the first record for Kauai. This is a specific feeder on laulaha and is always present in large numbers on its flowers. Several captures in the wind traps at Kunia indicate that this species upon the wilting of host flowers migrates to other fresh ones; this is one of the thrips common in flight.<sup>5</sup>

**\*Hoplothrips flavitibia** Moulton

Haena: *Eugenia Cumini* (Java plum), under bark of log.

<sup>4</sup> See p. 283 of this issue [Ed.].

<sup>5</sup> See also Carter, W. Populations of *Thrips tabaci*, with special reference to virus transmission. Jour. Animal Ecol., 8: 261-276, 1939.

Waimea: *Prosopis chilensis* (kiawe), under bark of fallen tree.  
 Lihue: no host record.

This common phloeophilous species was found to be widely distributed on Kauai, where it had not been recorded before. Extremely large colonies were found in the forest areas at both Haena and Waimea. It is interesting to note that this species was breeding on a fleshy fungus, "pepeiao" or "Jew's ear fungus" (*Auricularia* sp.), attached to a rotten log in the wet Waikapu Valley on Maui in April 1944 (1). This type of food has not been known; its usual food is rotten plant tissue and possibly microscopic fungi growing under bark.

**Haplothrips gowdeyi** (Frank.)

Haena: *Hippobroma longiflora* (Star of Bethlehem), flowers.

Lihue: sweeping.

Mana: *Brassica* sp. (shirona), leaves.

**\*Haplothrips (Hindsiana) sakimurai** Moulton

Waimea: no host record.

Attention was called to this species by F. A. Bianchi who found a single specimen among other insects collected there on the present trip. This native species was first collected on Oahu in 1930 and many specimens were subsequently caught in wind traps in 1935 (4); it has never been reported from the other islands. Although the species was once collected on *Emilia sonchifolia* which is suspected to be an accidental shelter plant, the true host was not known until Bianchi recently found this thrips common on nutgrass (*Cyperus rotundus*).

**\*Dichaetothrips setidens** (Moulton)

Lihue: *Casuarina* sp. (ironwood), dead branches.

*Psidium Guajava* (guava), dried fruits.

Three specimens of this giant spore-feeder, about 4 mm. long and one of the largest Hawaiian species, were caught by beating the dead branches of fallen ironwood and also by searching within small dry guava fruits still attached to branches. Both sites were moderately shaded but far from the native forest, yet these general areas were well covered with shade trees, wind breaks or border plantings. A single specimen of this species was also caught recently in a wind trap standing among the pineapple fields of the Kunia section, Oahu, in April 1944. Kunia is on the open, cultivated Wahiawa plain, miles away from the native forest. However, the nearby gulches support suitable type of vegetation for this spore-feeder and it is quite certain that this specimen must have been feeding there and not directly blown down from the forest. The type specimen was collected in Manoa Valley also during April.

The collections therefore seem to indicate that the open lowland is probably also a normal habitat of this species at least during the wet winter months, in addition to the native forest at the higher elevation.

This species was described from a single female collected on Oahu in 1927 (2), and later collected also from three other South Pacific islands: Marquesas in 1929 (7), Mangareva in 1934 (5), and Fiji in 1938 (6). Evidently this is a native, rather common species widely distributed in this region. The present lot is the second collection from the Hawaiian Islands but the first from Kauai. The four specimens are the first males to be taken; a brief description of these follows:

Size and color same as female; no further conspicuous thickening or enlargement of prothorax, fore femora or fore tarsal teeth than in female, abdomen conically tapered from segment II to tube, base of tube slightly more swollen. Measurements (in  $\mu$ ): Body length 3,600-4,500; head length 450-470, width 250-290; prothorax length 225-262, width excluding coxae 440-562; pterothorax width 625-725; abdominal segments width II 662-750, VIII 325-350, IX 225-250; tube length 460-550, width at base 125-140, at tip 56-59. Antennae: length (width); I, 59-65 (59); II, 75-79 (44); III, 144-147 (50); IV, 150-153 (50); V, 130-135 (44); VI, 94-100 (36); VII, 72-79 (29); VIII, 45-50 (21); total length 780-825. Fore tarsal teeth length 44-50; number of double fringe hairs on fore wing 42-46. Spines, postocular 162-180; anteocellar 38-50; postocellar 59-80; back of postocular spine 38-123; on anterior margin of prothorax 65-85; on anterior angles 100-120; mid-lateral 97-121; prominent on coxae 65-75; on posterior angles inner 138-150, outer 144-160; on abdominal segment IX, 460-520; at tip of tube 303-323; at base of fore wing 53-61, 100-162, 188-210.

#### THRIPS FROM HAWAII

##### *Heliothrips haemorrhoidalis* (Bouché)

Hilo: azalea, leaves.

Kilauea: rose, leaves.

Hualalai, 6,000-6,500 ft.: *Styphelia* sp. (maiele), leaves.

Waimea: no host record.

Peppeekeo Forest Reserve: *Vaccinium* sp. (ohelo), leaves.

This species was common throughout the wetter part of the island. Infestation was medium to heavy on both of the cultivated plants. Moderate populations were found on the native plants in the rain forest at the lower altitude as well as near the upper limit of the forest zone at extremely high altitude. The first three hosts are new records.

**Selenothrips rubrocinctus** (Giard)

Hilo: azalea, leaves.

An incidental number of this species was found among the previous species on this ornamental plant in a park. This is the first record from Hawaii and is a new host record.

**Anaphothrips (Chaetanaphothrips) orchidii** (Moulton)

Waimea: *Heimerliodendron Brunonianum* (papala kepau), flowers.

Light infestation was found on this native tree growing in the open gulch at the lower edge of the native forest (2,000 ft.). The present data and a series of others recently collected on Oahu clearly show that this introduced species is now well naturalized and rather common in the Hawaiian Islands; it is not only found on the various cultivated plants and weeds of the lowland but also on the grasses and other native or naturalized plants in the lower forest area. This species prefers moist surroundings and increases in populations are seen during the winter months. This is the first record from Hawaii and is a new host record.

The life cycle of this species feeding on the foliage of *Emilia sonchifolia* was found to be less than 33 days during January and February. The same length of life cycle feeding on citrus fruits during October and November has also been reported from Florida (12). All indications suggest that this species reproduces parthenogenetically in Hawaii. It bred parthenogenetically under confinement, and of 234 offspring all were females; furthermore a fairly large number of specimens collected from various sources were all females. The rate of multiplication on *Emilia* was much lower than that of *Thrips tabaci* which is a fast multiplying species.

**Taeniothrips alliorum** Pr.

Ahualoa: green onion, leaves.

Moderate populations, associated with subincidental populations of *Thrips tabaci* Lind., were found in a truck farm in this wet area. This is the first record from Hawaii and now this species is known from every Hawaiian island.

**Taeniothrips simplex** Morison

Ahualoa: gladiolus, leaves.

Heavy infestation was found among a few escaped plants growing along a moist roadside.

**Thrips hawaiiensis** (Morgan) and **T. hawaiiensis f. imitator** Pr.

Kilauea: *Astelia Menziesiana* (kaluaha), flowers.

Hualalai, 6,000-6,500 ft.: *Styphelia* sp. (maiele), flowers.

Holualoa: *Aleurites moluccana* (kukui), flowers.

Ahualoa: Hubbard squash, flowers.

Easter lily, flowers.

Malama Ki Forest Reserve, Puna: *Wikstroemia* sp. (akia), flowers.

Populations were moderate at the upper limit of the forest zone on Hualalai and small near the seashore among the rugged lava fields at Puna. Small populations were also seen on flowers of kaluaha in a dense fern forest and on flowers of kukui along a roadside in the moist area. Infestations on squash and Easter lily were medium and heavy respectively. *Astelia*, *Styphelia*, and *Wikstroemia*, all native plants, are new host records. The segregation of forms is as follows: *hawaiiensis*—22, *imitator*—18, and with anomalous antennae—four. As on Kauai, the dryland flower thrips, *Frankliniella* sp., was as scarce as this wetland species was abundant.

### **Thrips nigropilosus Uzel**

Waimea: *Arctium Lappa* (burdock or gobo), leaves.

A light infestation was found on a truck farm at an elevation of 2,000 ft. As shown in a previous paper (9), this species has been known since 1935 on Oahu, Kauai, and Maui and now Hawaii is added to its distributional list. The host is a new record for this species. This is a wetland species and heavy infestation is usually not seen on the dry lowland or during the dry summer months. Lettuce is sometimes injured in the uplands or in damp areas during the winter months. Serious injury to young seedlings of aster, as reported by F. G. Holdaway, was observed at Wailuku, Maui in February 1943. This is the first local case of damage reported on this ornamental plant.

### **Thrips tabaci Lind.**

Ahualoa: green onion, leaves.

Moderate populations of the dark form were found.

### **Subgenus *Isoneurothrips***

The subgenus *Isoneurothrips* is locally represented by the largest number of species among the indigenous Terebrantia. There are nine species already described and still more new species remain undescribed. One of the authors (KS) has had special interest in this group for some time and has been assembling the material for completion of a monographic treatise of this subgenus. In addition to several species from Kauai and Molokai reported in previous papers (8, 10), a long series of specimens collected in the uplands of Oahu are on hand. The present collections have brought in extremely interesting material, involving five forms in 13 different lots, all collected on native plants at high elevations in the Kilauea, Hualalai, and Waimea districts.

**Thrips (Isoneurothrips) antennatus** (Moulton)

Kilauea: *Vaccinium* sp. (ohelo), leaves.

*Astelia Menziesiana* (kaluaha), flowers.

Waimea: *Metrosideros* sp. (lehua), flowers.

Populations were large on kaluaha growing in a dense tree fern forest and were small on ohelo in a lehua forest, as well as on lehua on the lower edge of native forest, at 2,000 ft. The first two hosts are new records; this is the first record from the island of Hawaii.

Although these specimens have several features different from the type of *antennatus*, described from a single male in 1928 (2), they are tentatively identified as *antennatus*. However, the final conclusion is withheld for the monographic work. The unidentified specimens collected on *Broussaisia* sp., near Waikolu Valley, Molokai, (10) are identical with the present specimens, here assumed to be *antennatus*. The species identical with the present specimens is also common on various host plants in the upper forests of Oahu.

**Thrips (Isoneurothrips) williamsi** (Moulton)

Kilauea: *Sophora chrysophylla* (mamani), flowers.

Hualalai, 6,500 ft.: *Myoporum sandwicense* (naio), young leaves.

Small populations were found on mamani flowers in the dense forest at the Bird Park, and also on terminal leaf buds of naio trees in the open forest near the upper limit of the forest zone. These two hosts, both native, are new records. Although not recorded since the types were collected on Mt. Tantalus in 1926 (2), many specimens have been collected from widely scattered localities on Oahu. This is one of the common *Isoneurothrips* feeding on various flowers in the moist upper and lower forest areas. Its distribution and host range are not restricted to the forest areas or native plants. It was occasionally found on the floor of deep valleys, or on common weeds growing in the forests and introduced trees or vegetables growing in the city. As mentioned previously this species was also collected from Kauai, and is here recorded for the first time from the island of Hawaii.

**Thrips (Isoneurothrips) sp.**

Kilauea: *Vaccinium* sp. (ohelo), leaves.

*Sophora chrysophylla* (mamani), flowers.

*Urera sandwicensis* (opuhe), flowers.

Hualalai, 6,500 ft.: *Myoporum sandwicense* (naio), young leaves.

Unidentified composite, flowers.

Hualalai, 6,000-6,500 ft.: no host record.

*Rubus hawaiiensis* (akala berry), flowers.

Populations were small on ohelo in a lehua forest, and on mamani and opuhe growing together in a dense growth at the Bird

Park. At extremely high elevations on Mt. Hualalai, populations were small on naio but medium on akala berry, both growing in open forest; only incidental specimens were collected from the other two hosts. All specimens belong to a single group except the ones from akala berry which are slightly different in minor features from the rest. Upon comparison with the paratype, it was found that both forms are very closely related to but definitely different in several features from *I. fullawayi* which seems to be a variable or unstable species. So this species is tentatively determined as a species close to *fullawayi*. These atypical forms do not seem to be regional forms as they are also common on Oahu where the type specimens of *I. fullawayi* were collected. Although these three groups, one typical and two atypical forms, are probably in a varietal relationship, the final conclusion on the nomenclature will appear in the proposed monographic work later. Incidentally, *I. fullawayi* is one of the common *Isoneurothrips* in the forest areas and many native as well as introduced plants are known to be its hosts.

#### **Thrips (*Isoneurothrips*) sp.**

Hualalai, 6,000-6,500 ft.: *Styphelia* sp. (maiele), flowers.

Moderate populations were found on this shrub growing in an open forest near the upper limit of the forest zone. This species is remotely related to *I. fullawayi* but is definitely a different and unrecorded species.

#### **Hoplothrips flavitibia Moulton**

Hualalai, 4,500 ft.: rotten fence post.

Glenwood, Puna: under bark of fence post.

Small and moderate populations were found on the rotten fence posts along the pastures within the wet forest areas. This is the first record of its collection on Hawaii.

#### **(?) *Haplothrips* sp.**

Kilauea: *Metrosideros* sp. (lehua), leaves.

Two specimens were collected in a lehua forest. Further studies are needed for a specific determination.

### LIST OF THRIPS KNOWN FROM HAWAII

#### **Terebrantia**

*Organothrips bianchii* Hood

*Heliothrips haemorrhoidalis* (Bouché)

\*\**Selenothrips rubrocinctus* (Giard)

*Limothrips cerealium* Hal.

\*\**Anaphothrips* (*Chaetanaphothrips*) *orchidii* (Moult.)

*Frankliniella* sp.



- \*\**Taeniothrips alliorum* Pr.  
*Taeniothrips simplex* Morison  
*Thrips hawaiiensis* (Morgan) and *T. hawaiiensis* f. *imitator* Pr.  
 \*\**Thrips nigropilosus* Uzel  
*Thrips tabaci* Lind.  
 \*\**Thrips (Isoneurothrips) antennatus* (Moult.)  
*Thrips (Isoneurothrips) multispinus* Bagn.  
 \*\**Thrips (Isoneurothrips) williamsi* (Moult.)  
 \*\**Thrips (Isoneurothrips)* sp.  
 \*\**Thrips (Isoneurothrips)* sp.

### Tubulifera

- Dermothrips hawaiiensis* Bagn.  
*Hoplothrips barbatus* (Bagn.)  
*Hoplothrips coprosmae* Moult.  
*Hoplothrips dubius* (Bagn.)  
 \*\**Hoplothrips flavitibia* Moult.  
*Hoplothrips lanaiensis* (Bagn.)  
*Hoplothrips laticornis* (Bagn.)  
*Haplothrips gowdeyi* (Frank.)  
*Haplothrips (Hindsiana) williamsi* Moult.  
 \*\* (?) *Haplothrips* sp.

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\*\*Heretofore unrecorded from Hawaii.

### Additional Notes:

A small lot of thrips collected by W. C. Look at Hilo, Hawaii (one collection at Kilauea) during February and March, 1945 was forwarded while this paper was in press. Since this material is directly related to the subject matter of this paper, the following notes on the collection are added here:

*Heliothrips haemorrhoidalis* (Bouché). A colony was found on leaves of rhododendron at Kilauea.

*Selenothrips rubrocinctus* (Giard). A colony was found on leaves of passion fruit.

*Scolothrips sexmaculatus* (Perg.). A single specimen was collected from the colony of *S. rubrocinctus* mentioned above. This is the first record of its collection from Hawaii.

*Thrips hawaiiensis* (Morgan) and *T. hawaiiensis* f. *imitator* Pr.

This was abundant on various flowers during the rainy season. Flowers of gardenia and *Dendrobium* orchid were heavily infested. Other flowers infested were *Vanda* orchid, *Cattleya* orchid, macaranga, avocado pear, and pole bean.

*Stulothrips trespinus* Moulton. Hundreds were found on leaves of sugarcane and "ti" and in houses in one specific area. This swarming must have occurred during migration. This is the first record from Hawaii.

*Haplothrips gowdeyi* (Frank.). A colony was found on flowers of *Emilia sonchifolia*.

(?) *Haplothrips* sp. A single specimen was collected from macaranga. This specimen differs from any species heretofore recorded from the Hawaiian Islands, including the one mentioned on page 329, and further studies are needed for a specific determination.



Location of Type Specimens of *Trioza koebelei* Kirkaldy  
(Homoptera, Psyllidae)

By O. H. SWEZEY

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of July 10, 1944)

*Trioza koebelei* Kirkaldy, Can. Ent., 37: 290, 1905

*Spaniotrioza morelosiana* Kirkaldy (MS.)

I HAVE recently had inquiries from two different sources as to the location of the type of *Trioza koebelei* Kirkaldy: Dr. John S. Caldwell, Circleville, Ohio and Dr. Leonard D. Tuthill, Ames, Iowa. Both of these gentlemen had specimens of Psyllidae which they wished to have compared with the type of *Trioza koebelei*. This type should be located at the Experiment Station, H.S.P.A., but on searching through the collections, I failed to find any type or other specimens labelled *Trioza koebelei*. However, in the collection of Psyllidae determined by Kirkaldy, were a type and several paratypes labelled "*Spaniotrioza morelosiana* Kirkaldy". On comparing these specimens with Kirkaldy's description and figure of *Trioza koebelei* in the Canadian Entomologist, it was found that they agreed well, which leads to the presumption that Kirkaldy had intended to erect the genus *Spaniotrioza* for the species *morelosiana*, and then later changed his mind and described and published it as *Trioza koebelei* instead, but neglected to change the label which he had already put on the type specimen. (He was known to have made similar lapses on other occasions.)

*Spaniotrioza* could not be found in lists of genera: Zoological Record, or Neave's Nomenclator Zoologicus. Furthermore, the specimens labelled "*Spaniotrioza*" are also labelled with the red number 1780 and "Morelos, Koebele", the number corresponding to the same number in Koebele's field notebook, where he records a psyllid collected on avocado leaves at Morelos, Mexico. This is the same information that is given by Kirkaldy as to the habitat of *Trioza koebelei*. Considering all of this, it seems that the evidence is conclusive that the type and paratypes labelled by Kirkaldy *Spaniotrioza morelosiana* are really the specimens which Kirkaldy described and published as *Trioza koebelei*.



Notes on *Graptostethus servus* (Fabr.) in Hawaii  
(Heteroptera: Lygaeidae)

By O. H. SWEZEY

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of November 13, 1944)

My first record of this bug in Hawaii (Proc. Haw. Ent. Soc. 11: 284, 1943) was based on a single specimen, and it was provisionally named *Graptostethus nigriceps* Stål, pending the obtaining of more specimens for further study. Since that time, single specimens have been obtained here and there at widely distributed localities on Oahu, and in some instances quite a concentration occurred, so that now enough specimens are at hand to show a considerable variation in coloration and allow for a more definite consideration of the species. A more intimate study of the 60-odd specimens at hand shows that it cannot be *nigriceps*, for with all the variations in color, none has a black head. The head in all specimens is red, with tylus black and there is more or less black at the posterior margin of the head. In most specimens the black markings on the pronotum are like the figure of *servus* in Fauna of British India (Rhynchotha, 2: 9, 1904), but there are specimens with pronotum red except for the two round black spots near middle of disc. The hemielytra, too, have mostly the black coloration of the above figure of *servus*. (See also my figure 1.) However, a few specimens have red hemielytra without black markings, except that the membrane is black, and it has a small white spot at basal angle below apex of clavus, and also white apical margin as in *servus*. The rostrum is black and extends to the posterior coxae as in *servus*, not elongate as in *nigriceps* in which the rostrum extends well beyond the posterior coxae. Taking it all in all, it seems safe to call our immigrant bug *Graptostethus servus* (Fabr.) even though it displays a greater variation in color than has been accounted for previously in the literature.

The first specimen of *Graptostethus* to come to notice in Hawaii was a specimen caught in a wind trap in a pineapple field in the Kunia district of Oahu, July 21, 1942, by Mr. K. Sakimura of the Pineapple Research Institute. Subsequently specimens have been taken at various localities on the islands of Oahu and Kauai, as follows:

(All of the following records are for Oahu, unless Kauai is specified)

- 2 Jan. 18, 1943, Honolulu, in package of capsules of *Ipomoea tuberosa* for shipment, (Krauss)

- 2 Jan. 19, 1943, Pacific Heights, in capsules and on foliage of same plant, (Krauss)
- 1 May 15, 1943, Kalihi, on eggplant, (Look)
- 1 May, 1943, Kipapa, on corn, (Pemberton)
- 1 June 20, 1943, 2044 Lanihuli Drive, Manoa Valley, on hibiscus, (Swezey)
- 1 May 31, 1943, Experiment Station, H.S.P.A., on window of entomology laboratory, (Williams)
- 1 July 20, 1943, Experiment Station, H.S.P.A., on window of entomology laboratory, (Williams)
- 1 Dec. 1, 1943, Experiment Station, H.S.P.A., on window of entomology laboratory, (Williams)
- 1 Dec. 29, 1943, Experiment Station, H.S.P.A., on window of entomology laboratory, (Williams)
- 1 Sept. 22, 1943, Experiment Station, H.S.P.A., on unrecorded plant, (Sa Ning)
- 1 Dec. 17, 1943, Kailua, on corn, (Urata)
- 3 Feb. 17, 1944, Experiment Station, H.S.P.A., on *Ipomoea tuberosa*, mostly in old capsules, (Swezey)
- 2 March 3, 1944, Experiment Station, H.S.P.A., on *Ipomoea tuberosa*, mostly in old capsules, (Swezey)
- 1 March 30, 1944, Experiment Station, H.S.P.A., on *Ipomoea tuberosa*, mostly in old capsules, (Swezey)
- 4 May 1, 1944, Experiment Station, H.S.P.A., on *Ipomoea tuberosa*, mostly in old capsules, (Swezey)
- 1 May 13, 1944, Experiment Station, H.S.P.A., on *Ipomoea tuberosa*, mostly in old capsules, (Swezey)
- 1 May 18, 1944, Experiment Station, H.S.P.A., on *Ipomoea tuberosa*, mostly in old capsules, (Swezey)
- 1 June 12, 1944, Experiment Station, H.S.P.A., on *Ipomoea tuberosa*, mostly in old capsules, (Swezey)
- 1 May 1, 1944, McCully Street, Honolulu, (Pemberton)
- 1 May, 1944, Kauai, on flowering *Heliotrope*, (Stephen Au)
- 1 July 23, 1944, Kaimuki, on eggplant, (Nishida)
- 1 July 21, 1944, Waimea, Kauai, on corn, (Davis)
- 1 Aug. 4, 1944, Kuliouou, in trash, (Rosa)
- 2 Aug. 11, 1944, Kuliouou, in trash, (Rosa)
- 1 Sept. 29, 1944, Waianae village, in house, (Hilda Swezey)
- 1 Oct. 13, 1944, Experiment Station, H.S.P.A., in spider web in entomology laboratory, (Williams)
- 1 Oct 14, 1944, Experiment Station, H.S.P.A., (Van Zwaluwenburg)
- 6 Oct 13, 1944, Experiment Station, H.S.P.A., in old capsules of *Ipomoea tuberosa*, (Swezey)
- 1 Nov. 2, 1944, Summit of Mt. Kaala, on *Erechtites*, (Williams)
- 1 Nov. 7, 1944, Grove Farm, Lihue, Kauai, on *Crotalaria* by roadside, (Pemberton)
- 1 Nov. 13, 1944, Experiment Station, H.S.P.A., on *Euphorbia hirta*, (Williams)
- 1 Nov. 21, 1944, Experiment Station, H.S.P.A., on laboratory window, (Williams)
- 1 Nov. 22, 1944, Experiment Station, H.S.P.A., on laboratory window, (Williams)
- 1 Dec. 9, 1944, Experiment Station, H.S.P.A., on laboratory window, (Williams)
- 1 Dec. 17, 1944, 2044 Lanihuli Drive, Manoa Valley, on sweetpotato, (Swezey)

Besides the above records, the bug was captured more abundantly in the wind traps operated by Mr. Sakimura in pineapple fields at

Kunia during 1943 and 1944. On examination of 39 specimens from this source collected June 8, 1943 to August 15, 1944, 18 were found to be of the red form (fig. 1 B) and 21 had the heavy black markings (fig. 1 A). Of the red specimens, half were females and half were males. Of the dark forms, there were 13 females and eight males. About the same proportion of coloration and sex holds for the other specimens at hand. This shows definitely that the difference in coloration is not a sexual character.

In 1943 when an occasional *Graptostethus* was being taken on windows of the entomological laboratory at the Experiment Station, H.S.P.A., attempts were made to discover the probable food-plant of the bug. Feeding was observed on the following when offered at different times separately in cage: tender terminal foliage of hibis-

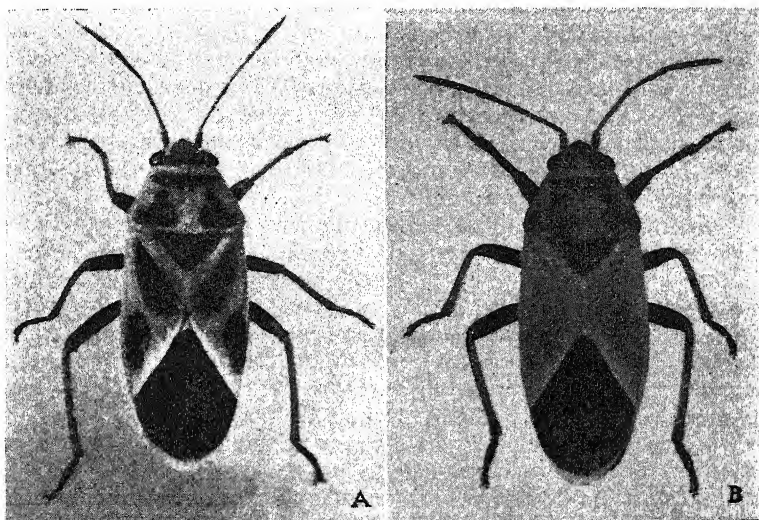


Fig. 1. *Graptostethus servus* (Fabr.).

- A. Form with thorax, clavus and corium red and having black markings.  $\times 5$ .
- B. Form with thorax, clavus and corium mostly red.  $\times 5$ .

cus and cotton, buds of *Sonchus* and *Emilia*, hibiscus bud and blossoms, *Euxolus*. Feeding was not observed on *Portulaca*, amaranth, sweetpotato, pigeon pea or tender foliage of *Ipomoea tuberosa* Linn. One bug lived for a month under this experimenting.

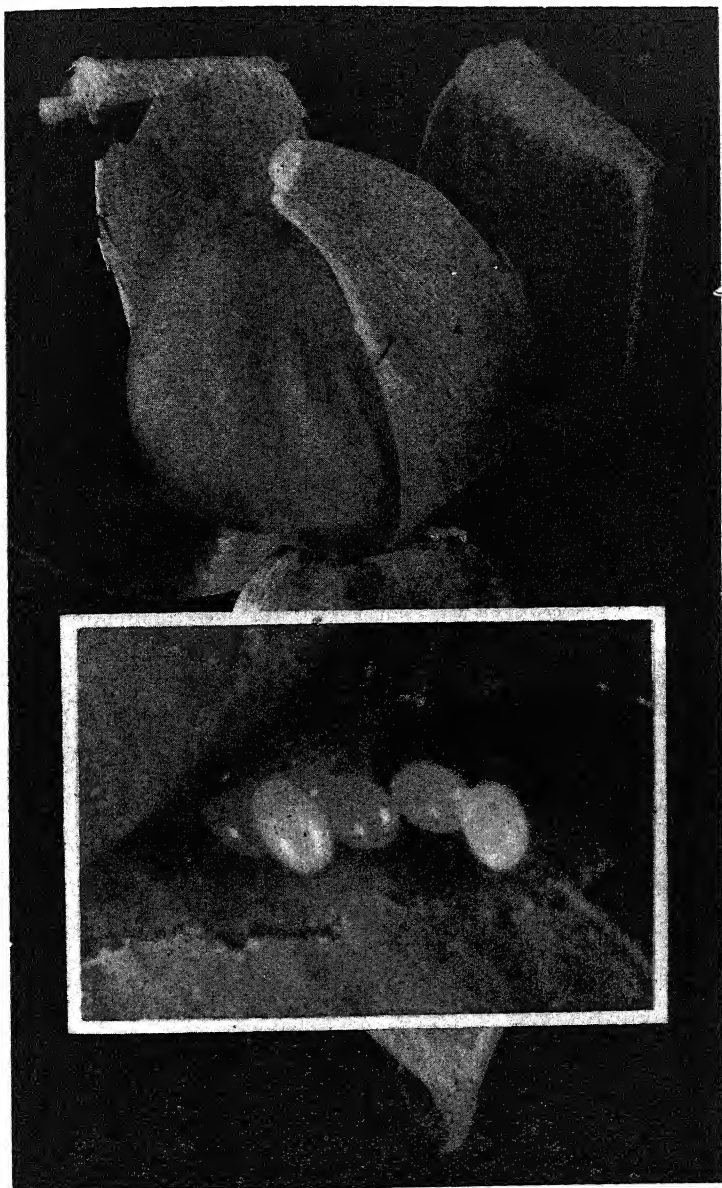
On Feb. 17, 1944 three adult bugs and one nymph were obtained by sweeping on *Ipomoea tuberosa* vines which are on a fence just outside of the entomological laboratory windows at the Experiment



Station, H.S.P.A. The finding of the nymph on this vine would indicate the probability that this was a food-plant. When the bugs were kept in a glass jar with buds of this plant, no feeding was observed. On March 3, a pair was observed *in cop.* on a dry capsule of the same vine, and a small nymph was found in an old capsule which was split at the base. Then on March 7, four adults were found singly on leaves, also two nymphs, one of which was in the last instar and matured in a few days; and three young nymphs were found between sepals at the base of an old capsule: further evidence that this was the food-plant. Search was made for eggs but none found. On March 11, small nymphs of various sizes were numerous in old capsules, about 40 in one capsule. The capsules were split at the base and gave access to the nymphs which were probably merely hiding there. May 1, two pairs of *Graptostethus*, freshly caught, were placed in a cage with a sweetpotato plant. No feeding was noticed, nor oviposition, but on May 12 it was found that eggs had been placed loosely in a cotton plug in the cloth cover of the cage, and four had already hatched. The next day six more hatched. These young bugs were given tender foliage of sweetpotato for feeding and later on pieces of ripe papaya fruit, none went through to maturity, however. Some died after nine days, and one lived for three weeks.

On May 12, a captured female bug was placed in a vial with hibiscus bud. The next day four eggs were found placed loosely in the cotton plug of the vial. The egg measured 1 mm. by 0.6 mm., with symmetrically rounded ends, shining white with a slightly yellowish tinge. After four days these eggs were light pink; on the seventh day one end was darkened by the developing embryo, and hatching took place in nine days. These were carried on for about two weeks before they finally succumbed.

Having gained a clew to the oviposition, and what the eggs were like, further attempts were made to find the eggs in the open, without success, however. Oviposition was obtained in cages, though, in the following positions. On June 10, a captured female was placed in a jar with new leaves of *Ipomoea tuberosa* and some old dry capsules. On examination a few days later, eggs were found as follows: two on bottom of jar under debris, one on sepal near base, two at base of capsules between it and sepal, nine in a group or cluster where they had been inserted at the base between a dried sepal and the capsule. (See plate.) On June 24, a cotton boll which was split so as to expose the cotton was put in cage with two pairs of bugs. When examined after six days, 30 eggs were found as follows: five in cluster between calyx and capsule at base, two separate on inner surface of a carpel of the capsule, 10 in clusters of five in the exposed cotton, 13 isolated and loose in the cotton.



*Graptostethus servus* (Fabr.)

Eggs *in situ* at base of *Ipomoea* capsule,  $\times 2$ ; highly enlarged in inset.

Although *Ipomoea tuberosa* is the only plant on which nymphs have been observed, I do not consider that it is the sole food-plant of this bug. The adult bugs have been found on quite a variety of other plants, but, as in each case there was only a single specimen, I do not consider these records as positive indication of food-plant. There is no evidence yet that this bug is becoming a garden pest here. Dr. Fletcher, in "Some South Indian Insects" (p. 482), records *Graptostethus servus* on red-gram (*Cajanus indicus* Spreng.), sweetpotato and jute (*Corchoros*) capsules, but "Scarcely a pest, but may do damage at times".

**Podagrion mantis Ashm., a Parasite of Mantis Eggs in Hawaii  
(Hymenoptera: Callimomidae)**

By O. H. SWEZEY

Experiment Station, H.S.P.A., Honolulu

(Presented at the meeting of October 9, 1944)

A SINGLE SPECIMEN of this parasite was collected by Mr. Noel Krauss, on Molokai, May 31, 1943. Its identity and habits were not known at once, but it was suspected that it was an egg-parasite of the introduced Chinese mantid, *Tenodera angustipennis* Sauss., which is so widely distributed in the Hawaiian Islands. Hence, search was made on Oahu for mantis eggs to determine if they might possibly be parasitized. The first evidence of the presence of the parasite on Oahu, was the finding of an ootheca containing exit holes of a parasite, by Dr. Lyon on his garage. This was reported at the meeting of the Hawaiian Entomological Society, January 10, 1944 (this issue, page 214).

From eight oothecae collected February 4, 1944, by Mr. Bianchi and myself, on hibiscus branches and other shrubs and on buildings at the H.S.P.A. substation in upper Manoa Valley, 78 female parasites and nine males issued between Feb. 4 and March 20. This was the first rearing of the parasite. Only females issued during the first ten days, and it appeared that the parasite might be parthenogenetic. The very few males came later.

On Feb. 14 to 17, five of the earlier females that issued as above, and hence, unmated, were placed with an unhatched ootheca. Oviposition was observed. Between March 9 and 17, 148 male parasites issued, the time of development being three to four weeks. No females issued. Six mantids hatched March 16 and 17.

The identity of the parasite was suggested when reference was made to an article by Henry Fox (Ann. Ent. Soc. America, 32: 561-563, 1939), where he discusses *Podagrion mantis* Ashm. as an egg-parasite of the native mantid, *Stagmomantis carolina* (Johannson), in eastern United States, and also of the introduced mantid *Tenodera angustipennis*. Specimens were sent to Dr. Muesebeck, who replied in a letter of March 9, 1944, that Mr. Gahan confirmed the identity as *Podagrion mantis* Ashm.

On March 14, 1944, 25 oothecae were collected at the same locality as the February lot, the most of which were old and had exit holes where parasites had issued. Five of the oothecae were more recent, and from one of them 35 female and four male parasites issued between March 15 and 30. Nothing hatched from two

of the remaining oothecae. Apparently they had been unparasitized, and the young mantids had issued at some time prior to the time that we collected them. From the last remaining ootheca 151 mantids hatched March 18 to 21, and no parasites issued.

On March 15, a freshly-mated female *Podagrion* was placed with what appeared to be an unhatched ootheca. From this ootheca numerous mantids hatched on April 12 and five more on April 15; also 32 female and two male *Podagrion* issued between April 12 and 16. Thus the progeny of this one female was 34, and the development took about four weeks.

Also on March 15, a freshly-mated female *Podagrion* was placed with an unhatched ootheca collected that day from a wooden fence post at the Experiment Station, H.S.P.A. Numerous mantids hatched on April 2, and 45 females and four males of *Podagrion* issued between April 12 and 23, the total of this progeny being 49 parasites, and the time of development being about the same.

From an ootheca collected July 3, 1944 on a post at Experiment Station, H.S.P.A., 33 mantids hatched July 24, and between July 20 and 26, 151 females and 14 males of *Podagrion* issued, a total of 165 parasites, the largest number so far obtained from a single ootheca.

From four oothecae collected by Mr. Bianchi in Woodlawn, Manoa Valley, November 23, 1944, parasites issued respectively: 53 females and six males; 84 females and 23 males; 21 females and two males; 55 females and eight males. From two of these oothecae mantids also hatched, respectively: 28 and 42.

The mantis has been noticeably scarcer on Oahu of late years, and the finding of this parasite so thoroughly established explains the scarcity of the mantis. From the present observations there are always some eggs in each ootheca which escape being parasitized. This indicates that the mantis may not become entirely exterminated, but will no doubt exist at a very low ebb.

At the January 1944 meeting of the Hawaiian Entomological Society Mr. Krauss reported having found mantis oothecae on Kauai having exit holes of the parasite; and at the July meeting, Mr. Bianchi reported finding on the island of Hawaii, above Hilo, mantis oothecae with exit holes of the parasite. Thus, *Podagrion mantis* is known to occur on four of the main islands of the Hawaiian group: Molokai, Oahu, Kauai and Hawaii.

## Insects Associated with Orchids

By O. H. SWEZEY  
Consulting Entomologist  
Experiment Station, H.S.P.A., Honolulu

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## INTRODUCTION

In the state of nature, most plants are found to have certain species of insects feeding upon them, which feed exclusively upon each particular kind of plant and never on any other plant. These insects are said to be *attached* to their respective food plants. Thus, among well-known garden plants the cabbage has certain insects attached to it; beans have certain other particular insects attached to them; beets, onions, potatoes, corn, cane, etc. each has its own attached insects. Ornamental plants similarly have their natural insect associates, and the orchids are no exception. Scores of insects are known, attached to orchids in their natural habitats and, no doubt, with further study in these habitats, the number will be greatly increased.

When plants are transported from one region to another, there is likelihood of some of their attached insects being carried with them. There are many noted examples of the disastrous results which followed the accidental introduction of insect pests to new regions by being carried along with their natural host plants. During the past 40-50 years, every known method has been resorted to in an endeavor to prevent the introduction of insects with new plants that are introduced from one country to another. Notwithstanding, and in spite of, the precautions taken when orchids have been imported to Honolulu from Central and South America, Australia, the Philippines and elsewhere, some insects have accompanied them at times and have succeeded in becoming established in orchid houses in Honolulu. A large number of species have been successfully intercepted by the Plant Quarantine Department and prevented from becoming established here.

The most of our knowledge of what insects are associated with orchids has been gained by the inspection of orchids from other countries or regions, rather than by special study of them in the respective regions which are their natural habitats. The insects treated of, or listed here, are largely those that have been recorded in lists of insects recorded as interceptions by the plant quarantine inspectors at the several ports of entry of the United States. Lists of all such interceptions are printed annually, giving the port of entry, the place of origin and the host plant on which each species was found.

As an example of how orchids can harbor insects and carry them while being imported, in the year 1917, seventy-three distinct species of insects were collected on orchids being imported into the United States, sixty-four of which were from South America. (Sasscer, Journ. Econ. Ent., 11: 128, 1918).

About fifty species have been intercepted on imported orchids at Honolulu from the various tropical countries. Not all of the species are especially orchid insects, as many ants and scale insects which have been thus intercepted are not attached to the orchid plant, but are more general in their habits, or their presence was incidental.

The records of interceptions in the following pages were chiefly taken from the annual reports of the U. S. Bureau of Entomology and Plant Quarantine, Lists of Intercepted Plant Pests, for the 10-year period 1932 to 1942.

Many records of insects injuring orchids were found also in the volumes of *The Review of Applied Entomology*, A, 1913-1940, and in several text books on orchid culture.

In each order, the insects attached to orchids are treated of at first, then follows a list of other species which have been intercepted on orchids, but whose presence might be considered as casual, or incidental, or which may have gained access to the package at the time of packing, or during transit. This segregation may not be entirely accurate, and might perhaps present an entirely different arrangement if a thorough study were made of the insects on orchids in their respective natural habitats.

## CURCULIONIDAE

### ORCHID WEEVILS IN HAWAII

Of the sixteen known species of orchid weevils (or beetles of the coleopterous family Curculionidae), which are known in various tropical regions of both hemispheres, four have been found on orchids in Hawaii, and yet two other species have been similarly found, which at present have not been determined as to name or original habitat.

The six weevils which have been found on orchids in Honolulu are borers within some part of the plant, and thus could often escape detection and also possibly withstand fumigation. Of course, too, perhaps some of them became introduced at a time prior to the present setup of quarantine methods, when no precautions were taken. Be that as it may, the following species have been found, mostly only occasionally, but at least one species sometimes increased to injurious numbers.

Much of my knowledge regarding orchid weevils in Hawaii has been acquired through the determination for Dr. Harold L. Lyon of specimens which, from time to time, have been found in his orchid houses, or on newly imported orchids. As I proceed, you will see that my notes on local conditions are often the recounting of these incidents.



1. *Orchidophilus aterrimus* (Waterhouse) (pl. XVII-B, fig. 2)

*Baridius aterrimus* Waterhouse, Ent. Mo. Mag., 10: 226, 1874.  
*Acythopeus aterrimus*, Lea, Trans. Royal Soc. S. Australia,  
 30: 101, 1906.

*Orchidophilus aterrimus*, Buchanan, Proc. Haw. Ent. Soc., 9: 45,  
 1935.

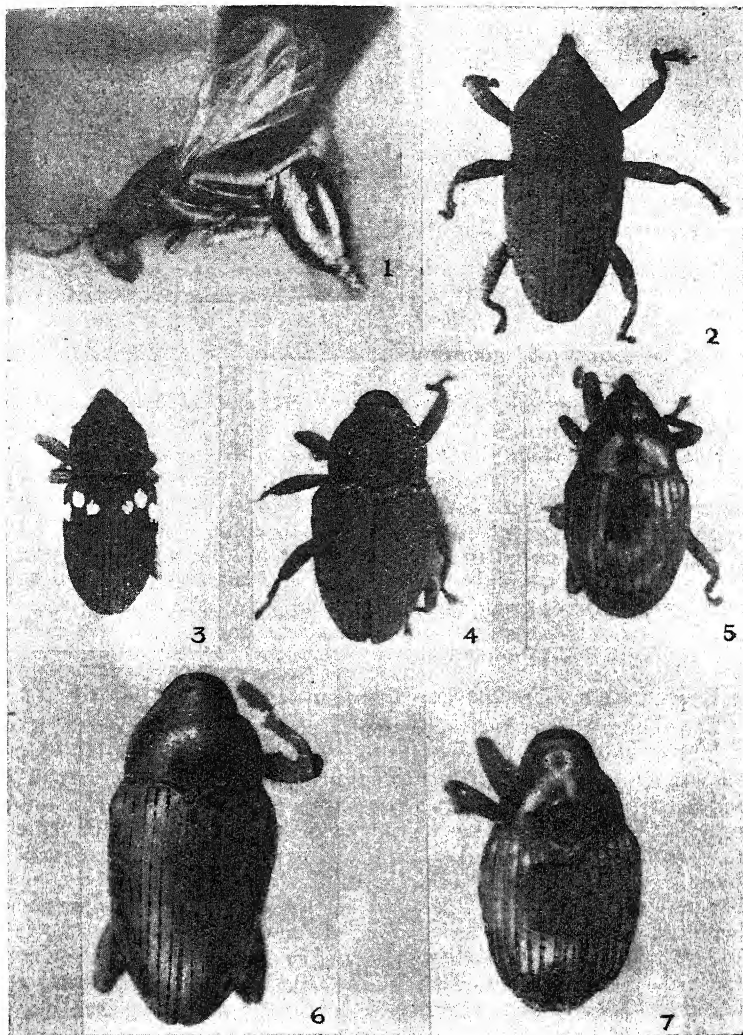
This is the largest of the orchid weevils which have been observed in Hawaii, being 3-6 mm. in length. It is black, with distinct striae on the elytra. (The illustrations will help in distinguishing the species of any specimens found in or on orchids.) This weevil has been intercepted many times in orchids from the Philippines and Straits Settlements, and there is no doubt of its having become introduced from that region. It was first observed in Honolulu in 1910, when it occurred in *Phalaenopsis* in the orchid house of Mr. W. H. Baird. The insect collection at Experiment Station, H.S.P.A., has specimens collected by Dr. H. L. Lyon since that time as follows: 1915, 1920, 1921, 1931, 1932, 1933, 1934, 1935, 1936, 1938, 1943.

The adult beetles feed on orchid flowers and on the tender tissues at or near the growing points. Larvae of the weevil have been taken in Honolulu from the stems of *Phalaenopsis*, *Vanda*, *Renanthera*, *Angraecum*, *Saccolobium*, *Dendrobium*, *Cymbidium* and *Spathoglottis*. This weevil has, at times become so numerous in some orchid collections in Hawaii that its permanent establishment in the Territory may well be feared. This is the more likely because it breeds freely in *Spathoglottis* which is now running wild over large areas on Oahu and Hawaii. As yet, we have no record of its occurrence on *Spathoglottis* in the field.

This weevil has been intercepted at Honolulu on *Vanda* sp. from Japan, on *Rhynchostylis retusa*, *Stauropis lissochiloides*, *Grammatophyllum multiflorum*, *Dendrobium victoria-reginae*, *Phalaenopsis sanderiana*, *P. schilleriana*, *Vanda luzonica*, *Spathoglottis intermedia*, *Trichoglottis brachiata* and *Acerides crassifolium* from the Philippines, on *Oncidium leopoldianum* from Dutch East Indies, on *Coelogyne asperata*, *Cypripedium curtisii*, *Dendrobium phalaenopsis*, *Renanthera alba* from Straits Settlements, on orchid from Thailand; in California on *Grammatophyllum speciosum*, *Vanda luzonica*, *Dendrobium superbum*, *Phalaenopsis schilleriana* and *Phalaenopsis amabilis* from the Philippines, on *Oncidium sphacelatum* and *Dendrobium pierardii* from Straits Settlements; at Washington, D.C. on *Grammatophyllum speciosum* from the Philippines.

2. *Orchidophilus peregrinator* Buchanan (pl. XVII-B, fig. 4)

*Orchidophilus peregrinator* Buchanan, Proc. Haw. Ent. Soc., 9  
 46, 1935.



Orchid Insects

1. *Eurytoma orchidearum* (Westwood) : Cattleya-fly  $\times 12$ .
2. *Orchidophilus aterrimus* (Waterhouse)  $\times 8$ .
3. *Orchidophilus gilvzonotatus* Barber  $\times 8$ .
4. *Orchidophilus peregrinator* Buchanan  $\times 9$ .
5. *Diorymerellus laevimargo* Champion  $\times 17$ .
6. *Pseudocholus* sp. (?)  $\times 10$ .
7. *Diastethus* sp. (?)  $\times 10$ .

This is a smaller black species; length 4 mm. It has been intercepted at Honolulu on orchids from the Philippines: *Phalaenopsis schilleriana*, *Phalaenopsis amabilis* and *Grammatophyllum multiflorum*. The only record of its occurrence in Honolulu was in 1928 in orchid house of Mr. F. C. Atherton. This weevil is apt to be confused with *aterrimus*, but the elytral striae are finer and not so pronounced as in the latter species. It has been intercepted also in California on *Vanda coerulea*, *Vanda luzonica*, *Renanthera* sp. and *Phalaenopsis amabilis* from the Philippines.

### 3. *Orchidophilus gilvonotatus* (Barber) (pl. XVII-B, fig. 3)

*Acythopeus gilvonotatus* Barber, Proc. Ent. Soc. Wash., 19: 17, pl. 4, figs. 3, 3-a, 1917.

*Orchidophilus gilvonotatus* Buchanan, Proc. Haw. Ent. Soc., 9: 45, 1935.

This is another black weevil, about the size of the preceding species; 4 mm. in length. It is distinguished from the two preceding species by having four clusters of yellowish scales on the basal third of each elytron. It is a Philippine species also, having been intercepted at Honolulu on *Phalaenopsis amabilis* from those islands. It probably is very rare in Honolulu, as the only specimen in the H.S.P.A. collection is from Dr. Lyon's orchid house, April, 1916. It has been intercepted also in California on *Phalaenopsis stuartiana* and *Phalaenopsis amabilis* from the Philippines. All of these three species of *Orchidophilus* are dull black, and the thorax is densely covered with coarse punctures.

### 4. *Diorymerellus laevimargo* Champion (pl. XVII-B, fig. 5)

*Diorymerellus laevimargo* Champ., Ent. Mo. Mag., 52: 201, 1916.

This is a very small weevil, barely 2 mm. in length. It is black, smooth and shiny, with distinct striae on the elytra. It was described from Central America. It has become quite a pest in the greenhouses in New Jersey from whence large numbers once came to Honolulu in a shipment of *Dendrobium phalaenopsis*. This shipment was held in a quarantine house for months until the weevils had all been destroyed. The adult beetles feed on the flowers and leaves of *Cattleya* and *Dendrobium*; the larvae feed in the roots. It has never been very prevalent in Honolulu, as the few specimens in the H.S.P.A. collection were from *Dendrobium* in a quarantine house in 1914 and 1915, and a single specimen collected by Dr. Lyon on flower of *Laelia anceps* at Foster Garden in 1934.

### 5. *Pseudocholus* or *Ipsichora* sp. (pl. XVII-B, fig. 6)

A single specimen of a large black, shiny weevil, 5 mm. in length, was collected in 1932 by Dr. Lyon on orchid in the orchid house at Foster Garden. Dr. Marshall of the Imperial Institute of Entomology determined it as "near *Pseudocholus* or *Ipsichora*".

6. *Diastethus* sp. (pl. XVII-B, fig. 7)

This also was determined by Dr. Marshall, on a single specimen taken by Dr. Lyon on leaf of an *Oncidium* from Trinidad, 1935. It is a shiny, black species, with the elytra mostly an obscure red. Length about 3.5 mm. The striae on elytra are very distinct, wide and deep. The thorax has few minute punctures.

Probably the most efficient method of dealing with these weevils among orchids or in orchid houses is handpicking. The adult weevils having the habit of feeding more or less on foliage and blossoms, may be readily detected and collected and destroyed. But, as the larvae, which are footless grubs, are borers inside stems or fleshy parts of the plants and cause the most injury, which they may accomplish without external evidence of their presence until the main damage is done, it is a more difficult matter to get rid of them. However, at the first evidence, these larvae should be searched out and destroyed, which may entail the sacrifice of a plant or some vital portion of it. Fortunately, it is inferred that there is not much trouble by these weevils in Honolulu, else the entomologists would have heard more of them. Because they have been found here, even though rarely in some cases, it behooves the orchid fancier to be always on the alert to detect their presence, and to forestall any serious infestations.

## ORCHID WEEVILS KNOWN ELSEWHERE THAN IN HAWAII

1. *Cholus forbesii* Pascoe

Proc. Ent. Soc., London, 1876: xxx.

2. *Cholus cattleyae* Champion

Ent. Mo. Mag., 52: 201, 1916.

3. *Cholus cattleyarum* Barber

Proc. Ent. Soc., Wash., 18: 177, 1916.

These three weevils have been found in orchid houses in New Jersey and Wisconsin, especially on *Cattleya gigas*. The larvae feed in the pseudobulbs; the adults feed on leaves and pseudobulbs. These species are tropical American, and *cattleyarum* is a synonym of *cattleyae*. *Cholus cattleyae* has been intercepted at Washington, D.C. and in Puerto Rico on *Cattleya* sp. from Venezuela. *Cholus cattleyarum* was intercepted in California on *Cattleya* sp. from Colombia. *Cholus forbesii* was described from a specimen found among orchids in England, supposed to have been imported from Ecuador. It has been found established in orchid houses in New Jersey, and causing considerable injury.

4. *Cholus nigromaculatus* Champion

Biol. Centr.-Amer., 4 (4): 306, pl. 16, figs. 13, 13-a, 1903.

Described from Panama. Intercepted in California on *Laelia* sp. from Mexico.

**5. *Orchidophilus orchivora* (Blackburn)**

*Baris orchivora* Blkb., Trans. Royal Soc. S. Australia, 24: 61, 1900.

*Orchidophilus orchivora*, Buchanan, Proc. Haw. Ent. Soc., 9: 45, 1935.

This black weevil was described from Queensland, Australia. It was bred from pseudobulbs of *Dendrobium canaliculatum*. It became established in New Jersey greenhouses a number of years ago, where *Dendrobium fndlayanum* and *Dendrobium crystallinum* were the orchids specially attacked. It has been intercepted in California on *Dendrobium spectabile* from Borneo. It is dull black and smaller than *O. aterrimus*.

**6. *Apotomorrhinus orchidearum* Kolbe**

Gartenflora, 55: 4, 1906.

This black weevil is related to the species of *Orchidophilus*, and it is not certain whether it may be a synonym of one of the species. Little is known of it since its description in Berlin. Schlechter in 1927 lists it as a synonym of *Acythopeus aterrimus*.

**7. *Eucactophagus weissi* Barber**

Proc. Ent. Soc. Wash., 19: 21, pl. 4, figs. 4, 4-a, 4-b, 1917.

This is quite a large yellow and black weevil described from specimens in orchid houses in New Jersey where it has been troublesome. It is probably of tropical American origin. The larva lives in soft-bulbed orchids, and can be very injurious. It has been intercepted at Washington, D.C. on *Cattleya* sp. from Colombia.

**8. *Eucactophagus graphipterus* Champion**

Biol. Centr.-Amer., Coleoptera, 4 (7): 98, pl. 4, figs. 35, 35-a, 1910.

Another Central American weevil, which was once found in a New Jersey orchid house.

**9. *Eucactophagus biocellatus* Barber**

Proc. Ent. Soc. Wash., 19: 22, pl. 4, fig. 5, 1917.

This weevil was described from a single specimen from Canal Zone, Panama. It is presumably an orchid insect, though the author does not so state in his description which is included in a paper on orchid weevils.

**10. *Diorymerellus obliteratus* Champion**

Biol. Centr.-Amer., 4 (5): 252, 1908.

A small weevil described from the Antilles. Reported on *Ha-benaria* and *Vanilla* in Puerto Rico.

11. **Phloeophagosoma orchidarum** Marshall

Stylops, 1: 216, 1932.

Described from Java where it was reared from orchids. I have found no other record.

12. **Omobaris calanthes** Marshall

Bull. Ent. Research, 17 (3): 218, 1927.

This is a small shiny black weevil. Described from Java. The adults reported to damage the leaves of the orchid *Calanthe vera-trifolium*.

13. **Baris** sp.

Reported by Fullaway as intercepted on orchids at Honolulu.

14. **Tadius erirhinoides** Pascoe

Ann. Mus. Genova, (2) 2: 253, 1885.

Described from Macassar. It has been intercepted at Honolulu on *Phalaenopsis amabilis* and *Dendrobium taurinum* from the Philippines. Intercepted in California on *Cypripedium haynaldianum* from the Philippines.

15. **Ampelogypter** sp.

This weevil was reported in California as intercepted on orchid from New Jersey.

16. **Centrinus epidendri** Murray

Gardner's Chronicle, 1869: 1279.

Described in England from *Epidendrum* from South America. Schlechter, in 1927, apparently would consider *Acythopaeus aterrimus* a synonym of this species.

17. **Otiorhynchus sulcatus** (Fabr.)

*Curculio sulcatus* Fabr., Syst. Ent.: 155, 1775.

*Otiorhynchus sulcatus*, Kremnes, Tradgarden, Stockholm: 145, 1916.

The adults are reported in Sweden as damaging the leaves of orchids and several other kinds of plants in hot houses; the larvae attack the roots.

18. **Cylas formicarius** (Fabr.)

*Brentus formicarius* Fabr., Ent. Syst. Suppl.: 174, 1798.

*Cylas formicarius*, LeConte, Proc. Amer. Phil. Soc. 5: 327, 1876.

This sweetpotato weevil has been reported as intercepted in California in pseudobulbs of *Grammatophyllum speciosum* from the Philippines.

19. **Eucalandra setulosa** (Gyllenhal)

*Sitophilus setulosus* Gyllenhal, Schoen. Curcul.; 4 (2): 969, 1838.

*Eucalandra setulosa*, Csiki, Junk Col. Cat., pars. 149:77, 1936.  
Intercepted in New Jersey on *Cattleya* sp. from Colombia. The species was described from Mexico.

20. **Phelypera distigma** (Boheman)

*Phytonomus distigma* Boh., Schoen. Gen. Curc., 6 (2) : 344, 1842.

*Phelypera distigma*, Champion, Ann. Soc. Ent. France, 1867: 465.

Intercepted in California on *Cattleya deckeri* from the Canal Zone.

21. **Nassophasis foveata** Waterhouse

Trans. Ent. Soc. London, 1879: 18.

Described in England on orchid (*Aerides fieldingii*) from Khasia Hills, India.

22. **Nassophasis morreni** (Roelofs)

*Sphenophorus morreni* Roelofs, Ann. Soc. Ent. Belgique, 29: 10, 1885.

*Nassophasis morreni*, Schlechter, Die Orchideen: 899, 1927.

Described from Ecuador, also known from Brazil, and has been found in England on *Cattleya* from the tropics.

23. **Nassophasis orchidearum** (Voss)

*Sphenophorus orchidearum* Voss, Orchis, 6: 94, 1912.

*Nassophasis orchidearum*, Schlechter, Die Orchideen: 898, 1927.

Described from Central America and South America. The adult beetles feed on the flowers of *Odontoglossum* and *Dendrobium*.

24. **Conotrachelus naso** LeConte

Rhynchophora of North America: 231, 1876.

This weevil has been intercepted in California with orchid from Colombia.

## SCOLYTIDAE

1. **Xylosandrus morigerus** (Blandford)

Insect Life, 6: 264, 1894.

This scolytid beetle was described in *Dendrobium* from New Guinea. It attacks the stems, the adults boring in to make excavations for their young, as they are the "ambrosia" type of scolytid, the larvae feeding on fungus growth which develops in the excavations made by the adults. It has been intercepted many times in orchids imported from Australia, but apparently never became established in Honolulu. It was intercepted in California in *Dendrobium phalaenopsis* from Borneo and in *Dendrobium phalaenopsis schroederiana* from Australia.

Another species: *Xylosandrus morstatti* (Hagedorn) has been described from Africa where it is injurious to coffee. Both of these insects occur on orchids in Java, especially in *Dendrobium* stems.

## 2. *Xylosandrus luzonicus* (Eggers) ?

*Scolytoplatypus luzonicus* Eggers, Ent. Bl., 31: 244, 1935.

*Xylosandrus luzonicus*, U.S.D.A. Interception List for 1934: 74, 1935.

Intercepted at Honolulu on *Dendrobium taurinum* from the Philippines.

## 3. *Xyleborus perforans* (Wollaston)

*Tomicus perforans* Wollaston, Cat. Col. Madiera: 96, 1857.

*Xyleborus perforans*, Hagedorn, Junk Col. Cat., XXVI, pars 4: 108, 1910.

This beetle similarly sometimes attacks *Dendrobium* stems, but it also attacks many other plant stems or tree trunks, usually when in diseased, dying or dead condition.

# MORDELLISTENIDAE

## 1. *Mordellistena cattleyana* Champion

Ent. Mo. Mag., (2) 24: 56, 1913.

Described from beetles bred from leaves of *Cattleya* in England. The plants were believed to have been imported from Venezuela. The larvae of this beetle are leafminers in such orchids as *Cattleya labiata* from South America, and *Vanda coerulea* from India and Burma.

Intercepted at Washington, D.C., on *Epidendrum bifidum* from Dominican Republic, on *Cattleya* sp. from Colombia, on *Oncidium* sp. from Guatemala, on *Cattleya* sp. from Brazil. Intercepted in New Jersey on *Cattleya* sp. from Brazil, Venezuela, Colombia and Canal Zone.

## 2. *Mordellistena chapini* Ray

Proc. U. S. Nat. Museum, 84 (3016): 240, 1937.

Intercepted in Washington on *Cattleya* sp. from Colombia.

Described from a male specimen which issued from a leaf of *Cattleya* sp. intercepted at Washington, D.C. from Venezuela, and a male specimen taken as a leafminer in *Cailloga* sp. from Brazil, intercepted at Washington, D.C.

Also intercepted in New Jersey on *Cattleya* sp. from Peru, and on orchid from Colombia; in Texas on *Lycaste skinneri virginialis* from Mexico; at Washington, D.C. on *Cattleya* sp. from Colombia.

## 3. *Mordellistena epidendrana* Ray

Proc. U. S. Nat. Museum 84 (3016): 239, 1937.



Described from four specimens taken in leaves of *Epidendrum* sp. from Dominican Republic intercepted at San Francisco.

These three species apparently are attached to orchids.

4. **Mordellistena beyrodti** Lengerken

Zool. Jahrb. Jena, Abt. Syst., 44: 579-594, 18 figs., 1922.

This species is considered as a synonym of *M. cattleyana*. The citation above contains a full description of habits and life history, illustrated with 18 figures.

#### CERAMBYCIDAE

1. **Diaxenes dendrobii** Gahan

Ann. Mag. Nat. Hist., (6) 13: 520, fig., 1894.

This cerambycid beetle was described in England from specimens found associated with *Dendrobium nobile* plants imported from Burma. The leaves and pseudobulbs were injured. In 1897 this beetle was reported established in orchid houses in Great Britain, the adults eating the leaves, and the larvae feeding in pseudobulbs.

2. **Diaxenes taylori** Waterhouse

Ann. Mag. Nat. Hist., (5) 13: 128, 1884.

Described from a specimen gnawing off stems of *Phalaenopsis* in the Royal Nursery, Chelsea. The plants were from Manila. Later it was taken from stem of *Saccolobium coeleste*.

3. **Diaxenes phalaenopsis** Fisher

Ent. Meded. Ned.-Ind., 3: 53-54, 1937.

The adult beetles feed voraciously at night on the leaves of various orchids in Java and Sumatra. The larvae bore in the roots.

4. **Parmenonta valida** Thomson

Physis, 2: 158, 1868.

Intercepted in California on *Oncidium splendidum* from Mexico. Probably not an orchid insect.

#### HISPIDAE

1. **Agonia spathoglottis** Uhmann

Zeit. Wiss. Insekt. Biol., 24: 147, 1929.

Described from Sunda Islands and the variety *undata* from Buitenzorg, Java. This species is a leafminer in *Spathoglottis*.

2. **Callispa duodecimmaculata** Chapuis

Ann. Soc. Ent. Belg., 19: 17, 1876.

This 12-spotted hispid beetle was described from Java and the Philippines. It occurs on the leaves of *Spathoglottis plicata* and

other species of *Spathoglottis*. The larvae feed in the partly unfolded young leaves.

### 3. *Gonophora xanthomelaena* (Wiedemann)

*Hispa xanthomelaena* Wied., Zool. Mag. 2 (1) : 80, 1823.

*Gonophora xanthomelaena*, Gemm. & Har., Cat. Col., 11 : 3607, 1874.

This is a leaf-mining hispid beetle described from Sumatra, Java and Borneo. The larvae attack several kinds of orchids as: *Aurinda*, *Phalaenopsis*, *Spathoglottis* and *Vanda*.

### 4. *Oncocephala angulata* Gestro

Ann. Mus. Civ. Genova, 2 (2) : 172, 1885.

This is another leaf-mining hispid. Described from Sumatra, and occurs also in Java, in orchids of the genus *Coelogyne*, but does not cause much injury.

## CHRYSOMELIDAE

### 1. *Crioceris subpolita* Motsch. ?

Motschulsky, Etud. Ent., 9 : 22, 1860.

Both the larvae and adults of this yellowish chrysomelid beetle feed on the flowers of *Vanda* and *Spathoglottis* and other orchids in Java and Sumatra. They may also eat the fruit and leaves when flowers are not available.

### 2. *Lema pectoralis* Baly

Trans. Ent. Soc. London, (3) 4 : 9, pl. 1, fig. 3, 1865.

This leafbeetle was described from Singapore. It is reported in the Federated Malay States as feeding on *Vanda joaquim* flowers.

These two species may possibly be considered orchid insects.

## LIST OF INTERCEPTED BEETLES

Beetles which have been intercepted on imported orchids, but whose presence probably could be considered as casual, incidental, or accidental, and not specifically attached to orchids, are listed here.

Besides the beetles in the following list, quite a considerable number have been intercepted on orchids from various regions, but were determined only to genus or family. Many of them no doubt are the same insects as are included in the list.

## CHRYSOMELIDAE

### 1. *Physonota citrinella* Boheman

Intercepted in California on *Oncidium cavendishianum* from Guatemala.

2. **Physonota eucalypta** Boheman

Intercepted in California on *Laelia speciosa* and *Stanhopea* sp. from Mexico.

3. **Physonota mexicana** Boheman

Intercepted in California on *Laelia* sp. from Mexico.

4. **Plagiodera flosculosa** Stål

Intercepted in California on orchid from Mexico.

5. **Calligrapha aeneopicta** Stål

Intercepted at Washington, D.C., on orchid from Mexico.

6. **Calligrapha diversa** (Stål)

Intercepted in California on orchid from Mexico.

7. **Calligrapha notatipennis** Stål

Intercepted in Texas on orchid from Mexico.

8. **Calligrapha fulvipes** Stål

Intercepted in California on *Masdevallia* sp. from Costa Rica.

9. **Calligrapha pantherina** Stål

Intercepted in California on orchid from Mexico.

10. **Ogdoecosta catenulata** (Boheman)

Intercepted in California on orchid from Mexico.

11. **Ogdoecosta biannularis** (Boheman)

Intercepted in Texas on orchid from Mexico.

12. **Deloyala guttata** (Olivier)

Intercepted in Texas on orchid from Mexico.

## TENEBRIONIDAE

1. **Gonocephalum depressum** (Fabricius)

Intercepted in California on *Phalaenopsis sanderiana* from the Philippines.

2. **Mesomorphus villiger** (Blanchard)

Intercepted at Honolulu in orchid debris from the Philippines.

3. **Platydemus marseuli** Lewis

Intercepted at Honolulu in orchid debris from the Philippines.

4. **Zophobas morio** (Fabricius)

Intercepted at Washington, D.C., on *Cattleya* sp. from Venezuela and Colombia; in California on *Cattleya gigas* from Colombia.

5. **Tribolium castaneum** (Herbst.)

Intercepted at Honolulu on orchid shipment from Manila.

6. **Scleron ferrugineum** (Fabricius)

Intercepted at Honolulu on *Dendrobium macrostachyum* from the Dutch East Indies.

7. **Opatrinus gemellatus** (Olivier)

Intercepted in New Jersey on *Cattleya* sp. from Venezuela.

8. **Uloma fracticollis** Gebien

Intercepted at Honolulu with orchids from the Philippines.

## CUCUJIDAE

1. **Monanus concinnulus** (Walker)

Intercepted at Washington, D.C., on orchid from Colombia; in California on *Cattleya* sp. from Colombia.

2. **Telephanus setulosus** Sharp

Intercepted in Louisiana on orchid from Costa Rica.

3. **Telephanus grossicornis** Nevermann

Intercepted at Washington, D.C., on orchid from Colombia.

4. **Silvanus vulgaris** Grouvelle

Intercepted in California on *Cattleya* sp. from Colombia.

5. **Cryptamorpha dejardinsi** (Guer.)

Intercepted in New Jersey with *Schomburgkia* sp. from Trinidad.

## TRIXAGIDAE

**Trixagus trivialis** (Horn)

Intercepted at Honolulu on *Trichopilia suavis* from Canal Zone.

## LAMPYRIDAE

**Aspidosoma costatum** Gorham

Intercepted at Washington, D.C., on *Cattleya* sp. from Venezuela; in Puerto Rico on orchid from Venezuela.

## ELATERIDAE

**Aeolus pulchellus** Candèze

This beetle was intercepted in Texas with *Stanhopea* sp. from Mexico.

Several other Elateridae were intercepted, but determined only to genera.

## DERMESTIDAE

**Dermestes vulpinus** Fabr.

Intercepted at Honolulu in orchid packing from Manila.

## LYCTIDAE

**Lyctoxylon japonum** Reitter

Intercepted in California on *Phalaenopsis sanderiana* from the Philippines.

## COLYDIIDAE

**Minthea rugicollis** (Walker)

Intercepted in California on *Phalaenopsis sanderiana* from the Philippines, on *Cattleya* sp. from Colombia.

## ANTHRIBIDAE

**Araecerus fasciculatus** (Degeer)

Intercepted in California on *Dendrobium macrophyllum* from Borneo.

## HYDROPHILIDAE

**Oosternum costatum** Sharp

Intercepted at Washington, D.C., on *Lycaste aromatica* from Guatemala.

## SCAPHIDIIDAE

**Cyparium terminale** Matthews

Intercepted in California on *Oncidium cavendishianum* from Guatemala.

## PTINIDAE

**Ptinus tectris** Boieldieu

Intercepted in California on *Cymbidium lowianum* from India.

## MELANDRYIDAE

**Ischyomius chevrolati** Champion

Intercepted at Washington, D.C., on *Cattleya* sp. from Colombia.

## COCCINELLIDAE

**Epilachna varivestis** Mulsant

Intercepted in Arizona on orchid from Mexico.

## SCARABAEIDAE

**Trichius ornatus** Jordan

Intercepted in California on *Cymbidium eburneum* from India.

## ENDOMYCHIDAE

1. **Trochoideus americanus** Buquet

Intercepted at Washington, D.C., on *Cattleya* sp. from Colombia.

2. **Epopterus ocellatus** (Olivier)

Intercepted at Washington, D.C., on orchid from Venezuela.

3. **Acinaces lebasii** Gerstaecker

Intercepted at Washington, D.C., on orchid from Colombia.

## SCOLYTIDAE

**Xyleborus coffeae** Wurth

Intercepted in Kenya, boring in orchids from Queensland.

## HYMENOPTERA

## EURYTOMIDAE

**Eurytoma orchidearum** (Westwood) (pl. XVII-B, fig. 1)

Trans. Ent. Soc. London, 1882: 323, pl. 13, figs. 1-14.

This is the so-called "Cattleya fly", which, however, is not a true fly but a member of the order Hymenoptera. Described in the genus *Isosoma*, it stood in that genus for many years, but since 1923, it is found in *Eurytoma* in literature on economic entomology in the United States. It is a small insect, about 4 mm. in length, whose larvae were found feeding within buds and pseudobulbs of various species of *Cattleya* from Brazil. When first studied, it was thought to be a parasite of some other insect (which, however, was not discovered) since it is in a family which has chiefly parasitic habits. Later studies revealed that all species of the genus *Isosoma* are plant feeders, the larvae chiefly feeding in stems of various grasses. It was found established in greenhouses in Massachusetts as early as 1889, and was supposed to have come on plants imported from New Grenada (Colombia), South America.

In more recent years, it became the most important pest on orchids in the United States. It has many times been intercepted in imported orchids at Honolulu. It was established here as early as 1914, for in that year Dr. Lyon reared adults from orchids which had been obtained locally. He succeeded in eradicating them from his greenhouse, and apparently others have had similar results, for the pest has not come to our attention of recent years.

It has been intercepted many times at Washington, D.C., on *Cattleya* sp. from Venezuela, Colombia, Brazil and Costa Rica; in California on *Cattleya trianaei* and *C. gigas* from Colombia, on *C. mossiae* from Venezuela and on orchids from Brazil, New York and England; in New York on *Cattleya* sp. from Canal Zone; in New Jersey on *Cattleya* sp. from Brazil, Colombia, Venezuela and Peru.

#### XYLOCOPIDAE

##### **Xylocopa brasilianorum** (Linn.)

Intercepted at Honolulu in "orchid logs" from Manila.

#### FORMICIDAE (Ants)

Many kinds of ants have been found in packages of imported orchids. Sometimes colonies of ants are found among roots of imported plants. They may have been present on the plant or in the packing material when the packing was done, or they may have gained access at some time during transit. The most of them, as given in reports of interceptions were determined only to the genus, as: *Pheidole* sp., *Prenolepis* sp., *Solenopsis* sp., *Crematogaster* sp., *Ponera* sp., *Camponotus* sp., *Tapinoma* sp., *Tetramorium* sp., *Odontomachus* sp., *Dolichoderus* sp., *Tetraponera* sp., etc. No doubt, some of these were actually the same species as those which were specifically determined as follows:

##### 1. **Euponera luteipes** (Mayr)

Intercepted at Honolulu in orchid shipment from Manila.

##### 2. **Xenomyrmex stollii** Forel, var. **mexicanus**

Intercepted in California with *Oncidium cavendishianum* from Guatemala.

##### 3. **Iridomyrmex humilis** Mayr

Intercepted at Honolulu with *Cattleya trianaei* from California.

##### 4. **Monomorium carbonarium** (Smith) var. **ebenina**

Intercepted at Washington, D.C., in orchid packing from Colombia; in New York with *Oncidium phymatochilum* from Costa Rica.

##### 5. **Monomorium pharaonis** (Linnaeus)

Intercepted at Honolulu with orchids from Java and Manila.

##### 6. **Monomorium floricola** (Jerdon)

Intercepted at Honolulu in orchid shipment from Manila.

##### 7. **Pheidole anastasioi** Emery

Intercepted at Washington, D.C., with *Trichopilia* from Costa Rica.

8. **Pheidole javana** Mayr

Intercepted at Honolulu in orchids from Manila.

9. **Macromischa luciliae** Mann

Intercepted at Honolulu with *Oncidium splendidum* from Guatemala.

10. **Wasmannia auropunctata** (Roger)

Intercepted in Pennsylvania with orchid from Belgium; at Washington, D.C., with *Cattleya* sp. from Costa Rica; in Louisiana with orchid from Brazil; in Honolulu with several species of orchids from Canal Zone; in California with *Oncidium crispum* from Brazil and an orchid from Panama.

11. **Cyphomyrmex rimosus** (Spinola) var.

Intercepted at Washington, D.C., with orchid from Colombia.

12. **Dolichoderus bituberculatus** (Mayr)

Intercepted at Honolulu with *Dendrobium crumenatum* from the Philippines.

13. **Technomyrmex albipes** (Smith)

Intercepted in California with *Aerides lawrenciae* and *Grammatophyllum speciosum* from the Philippines; in Honolulu with *Dendrobium densiflorum*, *D. taurinum* and *Rhynchostylis retusa* from the Philippines, and several kinds of orchids from Straits Settlements; in Washington with *Dendrobium dearei* from the Philippines.

14. **Iridomyrmex iniquus** Mayr

Intercepted at Washington, D.C., with *Cattleya* sp. from Colombia and with orchid from Venezuela; in New York with orchid from Venezuela.

15. **Iridomyrmex iniquus nigellus** Emery

Intercepted in California with *Cattleya trianaei* from Colombia and *Cattleya* sp. from Venezuela; at Washington, D.C., with *Cattleya* sp. from Colombia and Venezuela and wild orchid from Costa Rica; at Puerto Rico with orchid from Venezuela; in the state of Washington with *Cattleya* sp. from Colombia.

16. **Iridomyrmex melleus** Wheeler

Intercepted at Honolulu with *Laeliocattleya* hybrid, *Cypripedium aladin* and *Phalaenopsis* sp. from France; at Washington, D.C., with *Dendrobium* sp. from France.



17. *Plagiolepis foreli* Santschi

Described from specimens found on orchids in the Botanical Gardens at Zurich.

18. *Plagiolepis longipes* (Jerdon)

Intercepted at Honolulu in orchid packing from Manila.

19. *Strumigenys lewisi* Cameron

Intercepted at Honolulu with orchids from Manila.

20. *Odontomachus haematoda* (Linn.)

Intercepted at Honolulu with *Grammatophyllum speciosum* from the Philippines.

## LEPIDOPTERA

## LYCAENIDAE

*Chliaria othona dendrobii* Roepke

*Chliaria dendrobii* Roepke, Teysmania, Batavia, 30 (3) : 115-121, 1919.

*Chliaria othona dendrobii*, Leefmans, Bandoeng, N.V., Mij., Varkink, 1931.

The larvae of this small blue and white butterfly injure orchids in Java and the Netherlands Indies. Several kinds of orchids are attacked: *Dendrobium phalaenopsis*, *Dendrobium mirbelianum*, *Phalaenopsis violacea*, *Phalaenopsis amabilis*, *Arundina* sp., *Spathoglottis* sp., *Phaius* sp. The larvae feed on the flower buds and can thus do great damage to plants in the open, but would not be expected to be present in a greenhouse.

## CASTNIIDAE

1. *Orthia therapon* (Kollar)

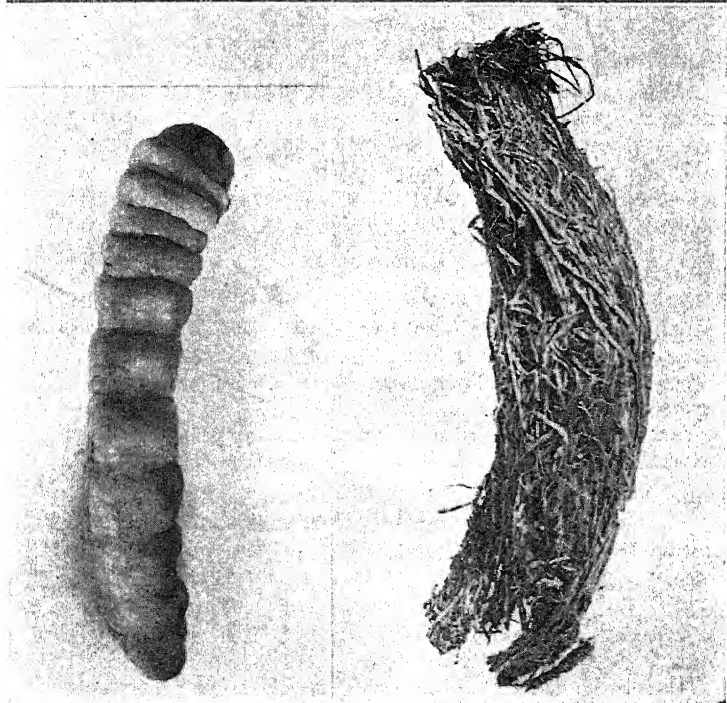
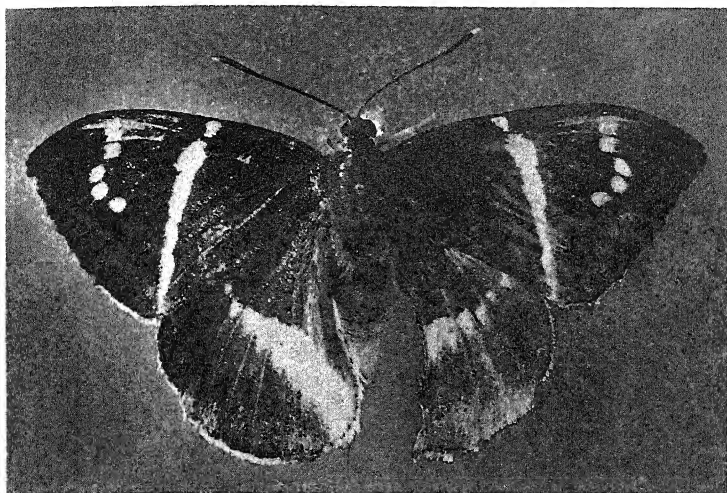
*Castnia therapon* Kollar, Lep. Bras. Ann. Wien. Mus. 2 : 218, pl. 13, fig. 3.

*Orthia therapon*, Schlechter, Die Orchideen : 870, 874, 888, 1927.

This large butterfly-like moth is a native of Brazil. It was reported in New Jersey orchid houses in 1916. The large caterpillars bore in the rhizome and up into the bulb of such orchids as *Oncidium crispum*, *Cattleya labiata* and *Catasetum* spp. It probably has occurred only in imported plants. It was intercepted at Washington, D.C., in *Cattleya* sp. from Brazil. It was once reared from a *Stanhopea* plant in orchid-house in England. The *Stanhopea* had originated in Brazil.

2. *Castnia cronis* Cramer var. *corningii* Edw.

Edwards, Insect Life, 3 : 316, 1891.



*Castnia licus* Fabricius

(Courtesy of Experiment Station, H.S.P.A.)

The variety *corningii* was reared from the roots of an orchid, *Laelia majalis*, at Albany, N.Y. The habitat was given as Oaxaca, Mexico.

Both of these large moths are likely to be transported as larvae within the rhizomes or bulbs of orchids coming from their home country, just as *Castnia licus* was reared in Honolulu in 1935 from the corm of *Heliconia angustifolia*, which was being held in quarantine greenhouse without the presence of the larva being known prior to the emergence of the moth.

### 3. *Castnia licus* (Fabricius) (pl. XVII-C)

*Papilio licus* Fabr., Ent. Syst. 3, 1: 45, 1793.

*Castnia licus*, Westwood, Trans., Linn. Soc., 2nd Series, Zool., 1: 173, 1875.

This large moth has been called the giant sugarcane borer, as its large larvae were found boring in sugarcanes in British Guiana. The larvae have also been recorded as feeding in orchid roots in the upper Orinoco Valley.

## GEOMETRIDAE

### *Negata chlorocrota* Hampson

The spanworn caterpillars of this geometrid moth feed on the leaves of several kinds of orchids in Java. The young caterpillars seek out the youngest leaves and eat off the upper epidermis; older caterpillars move to large leaves and eat the whole leaf substance, notching the margin. Also the blossom buds may be eaten, preventing flower development.

## LIMACODIDAE

### *Oxyplax ochracea* (Moore)

*Aphendala ochracea* Moore, Lep. Ceylon, 2: 129, pl. 129, figs. 3, 3a (Zoological Record, Insecta: 196, 1883).

*Oxyplax ochracea*, Hampson, Fauna Br. Ind., Moths 1: 376, fig. 256, 1892.

The larvae of this limacodid moth eat holes in the leaves of several kinds of orchids throughout Java; occurs also in Ceylon.

## LITHOSIADAE

### *Automolis inexpectata* (Rothschild)

*Halisidota inexpectata* Roths., Nov. Zool., 17: 70, pl. 13, fig. 25, 1910.

*Automolis inexpectata*, Hampson, Cat. Lep. Phalaenae, Brit. Mus., 2, Suppl.: 175, 1920.

Described from Venezuela and Peru. Has been intercepted in New Jersey on *Cattleya* sp. from Colombia.

## LIPARIDAE

1. *Orgyia postica* Walker

Cat. Lep. Br. Mus., 4: 803.

2. *Dasychira costalis* Walker

Cat. Lep. Br. Mus., 32: 365.

The hairy caterpillars of these two tussock moths feed on the leaves, inflorescence, flower buds and root tips of *Dendrobium* spp. in Java and the Netherlands Indies, also India. They are not confined to orchids, however, but feed on leaves of several other plants as well.

## PLUSIADAE

*Plusia chalcites* (Esper)

*Noctua chalcites* Esp., Nat. Eur. Schmett., 4: pl. 141, fig. 3, 1789.

The looping caterpillars of this moth sometimes destroy the buds of orchids growing in the open in Honolulu. *Phaius* and *Spathoglottis* are especially subject to attack.

## PSYCHIDAE

*Thyridopteryx ephemeriformis* (Haworth)

British Lepidoptera: 72, 1803.

This bagworm has been intercepted in California on orchids from Panama. It has a wide range of food plants in the eastern United States.

## PYRALIDAE

*Lamprosema schistisemalis* (Hampson)

*Nacoleia schistisemalis* Hamps., Ann. Mag. Nat. Hist., (8), 9: 632, 1912.

This pyralid moth has a range from the Bahamas and Panama to Argentina. It has been intercepted in New Jersey on orchids from Venezuela.

## TORTRICIDAE

*Platynota rostrana* Walker

Cat. British Museum, Lep., 28: 290, 1863.

The larvae of this tortricid moth have been reported feeding on leaves of *Vanilla* in Puerto Rico.

**Tortricid**

Intercepted at Washington, D.C., on *Dendrobium nobile* from India.

**Tortricid**

Intercepted at Washington, D.C., on *Cattleya* sp. from Venezuela.

**Olethreutid**

Intercepted at California on *Dendrobium secundum* from Thailand.

## COSMOPTERYGIDAE

**Cosmopteryx** sp. ?

Leafminers were found in orchids in New Caledonia by F. X. Williams. They failed to mature, but the pupae indicated that they might belong to this lepidopterous genus.

## ACROLOPHIDAE

**Acrolophus fervidus** Busck

Proc. Ent. Soc. Wash., 14: 222, 1912.

Described from Mexico and Costa Rica without mention of food plant. Has been intercepted at Washington, D.C., on *Cattleya trianaei* from Colombia.

Larvae of about a score or more of different kinds of moths have been intercepted with imported orchids, or in orchid packing, at several ports of entry and from various tropical regions, but were not specifically determined. Usually only named by genus and often only by family.

## DIPTERA

## CECIDOMYIIDAE

1. **Parallelodiplosis cattleyae** (Molliard)

*Cecidomyia cattleyae* Moll., Marcellia, 1: 165, pl. 2, 1903.

*Parallelodiplosis cattleyae*, Felt, N. Y. State Mus., Bull. 180: 89, 1915.

This is the *Cattleya* midge whose small yellow maggots live in galls on the roots of the plants, one to seven per gall. It is reported that in New Jersey, orchids imported from Guatemala often have the roots badly disfigured by these galls. Dr. Lyon relates the occurrence in Honolulu of the galls on roots of *Cattleya* imported from England, and that the maggots in the galls had survived fumigation. This is a demonstration of the uncertainty of killing insects within plant structures by fumigation. This pest has been intercepted a number of times on imported orchids, but is not known to have become established in Honolulu. It was intercepted on *Cattleya mendelli*, *C. triumphans*, *C. warscewiczii*, *C. gigas sand-eriana* and *Laeliocattleya* sp. from England, on *Cattleya deckeri*

from Canal Zone; at Washington, D.C., on *Cattleya warscewiczii sanderiana* from Colombia; in Louisiana on orchid from Costa Rica.

#### TEPHRITIDAE

##### 2. *Anastrepha striata* Schiner

This fruitfly was intercepted in New Jersey with *Cattleya* sp. from Venezuela.

#### ANTHOMYIIDAE

##### 3. *Helina buhri* Hering

This little fly is recorded as a leafminer in *Orchis latifolia* and *Orchis maculata* in north Germany.

### HETEROPTERA

#### PLANT BUGS ATTACHED TO ORCHIDS

##### MIRIDAE

##### 1. *Mertila malayensis* Distant

Ann. Mag. Nat. Hist., (7) 13: 113, 1904.

This bug is orange-red with legs and wings mostly indigo-black. Described from Singapore, and also recorded in Palawan, Burma, Java, India and the Netherlands Indies. It specially attacks *Phalaenopsis amabilis*, ovipositing in the leaves, and puncturing them to suck the sap. It has been intercepted in quarantine at Honolulu on *Aerides lawrenciae*, *Phalaenopsis sanderiana*, *Renanthera storiei* and *Vanda* sp. from the Philippines; in California on *Dendrobium taurinum*, *Phalaenopsis amabilis* and *Renanthera storiei* from the Philippines.

##### 2. *Tenthecoris bicolor* Scott

Ent. Mo. Mag., 23: 65, 1886.

Coloration red and purplish black, somewhat similar to the preceding bug. Described from South America; occurred on *Cattleya aclandiae* at Bahia, Brazil. It also occurs on *Laelia* and *Sophranitis*. It attacks orchids in cultivation and in the forest in Brazil. This bug has been intercepted at Honolulu on *Cattleya schilleriana* from Brazil; at Washington, D.C., on *Cattleya* sp. from Colombia and Venezuela; in California on *Cattleya gigas* from Colombia, on *Cattleya* sp. from Brazil, Colombia, Venezuela, Canal Zone, Costa Rica; in New Jersey on *Cattleya luddemanniana* from Venezuela, on *Epidendrum* sp. and *Laelia* sp. from Brazil, on *Oncidium* sp. from Trinidad; in Texas on orchids from Colombia, Venezuela and Mexico; in New York on *Cattleya mossiae*, var. from Venezuela; in Puerto Rico on *Cattleya mossiae* from Venezuela.

*Ecritotarsus orchidearum* Reuter is a synonym of the above.

### 3. *Neofurius carvalhoi* Costa Lima

Orquidea, 4 (3) : 104, 1942.

Described from orchids in Brazil, and I have found no other record.

### 4. *Neoneella zikani* Costa Lima

Orquidea, 4 (3) : 104, 1942.

Described from orchids in Brazil, and I have found no other record.

### 5. *Eurycipitia vestitus* (Distant)

*Eccritotarsus vestitus* Dist., Biol. Centr.-Am., Rhynch. Het. : 284, 1884.

*Eurycipitia vestitus*, U.S.D.A., Bur. Ent. and Plant Quarantine, Intercepted List, 1941 : 16.

Probably should be considered an orchid bug as it has been intercepted so frequently. Intercepted in California on *Cattleya luddemanniana* and *C. mossiae* from Venezuela, on *Epidendrum* sp. from Honduras, on *Oncidium cavendishianum* and *O. splendidum* from Guatemala, on orchids from Mexico and Colombia; in Texas on orchids from Mexico, Guatemala and Colombia; in New Jersey on *Cattleya* spp. from Brazil, Costa Rica and Guatemala; in Puerto Rico on orchids from Mexico and Guatemala; at Washington, D.C., on orchid from Venezuela.

## MISCELLANEOUS BUGS INTERCEPTED ON ORCHIDS

Besides the five preceding bugs, a large number of species has been intercepted, at one time or another, on imported orchids from several places. Apparently these were only incidentally present on the orchids and would not be considered as orchid insects. These were mostly of four families of plant bugs: Coreidae, Pentatomidae, Lygaeidae, and Miridae, but there were scattering ones in other families. The species of the following list were taken from U.S.D.A. records of interceptions on orchids during the years 1932-1942, and demonstrates the necessity of careful quarantine inspection to prevent introduction of some of these bugs which might become pests on many kinds of plants.

## CYDNIDAE

### 1. *Galgupha punctifer* McAtee & Malloch

Intercepted in Texas in soil around orchid plant from Mexico; in Louisiana on orchid from Honduras.

### 2. *Galgupha guttiger* (Stål)

Intercepted at Honolulu on *Oncidium luridum intermedium* from Dominican Republic.

3. *Geocnethus lugubris* (Stål)

Intercepted in California on *Cattleya trianaei* from Colombia.

4. *Geocnethus nigrocinctus* (Signoret)

Intercepted in New Jersey on orchid from Colombia.

## PENTATOMIDAE

5. *Lincus dentiger* Breddin

Intercepted at Washington, D.C., in orchid packing from Venezuela.

6. *Paralincus terminalis* (Walker)

Intercepted at Washington, D.C., on *Cattleya* sp. from Venezuela.

7. *Edessa cornuta* Burmeister

Intercepted in Arizona on orchid from Mexico.

8. *Mormidea collaris* Dallas

Intercepted in Texas on orchid from Mexico.

9. *Mormidea cubrosa* (Dallas)

Intercepted in Arizona and California on orchids from Mexico.

10. *Oplomus mundus* Stål

Intercepted in Texas on orchid from Mexico.

11. *Oplomus pulcher* Dallas

Intercepted in Texas on orchid from Mexico.

12. *Trichopepla californica* Van Duzee

Intercepted in California on *Laelia* sp. from Mexico.

13. *Pachycoris torridus* (Scopoli)

Intercepted in Texas on orchid from Mexico.

## COREIDAE

14. *Acidomeria rustica* Stål

Intercepted at Washington, D.C., on orchid from Nicaragua.

15. *Capaneus odiosus* Stål

Intercepted at Washington, D.C., on *Cattleya* sp. from Colombia; in California on *Laelia* sp. from Mexico; in Puerto Rico on *Cattleya* sp. from Venezuela.

16. *Anasa tenebricosa* Distant

Intercepted in California on *Laelia* sp. from Mexico.



## LYGAEIDAE

17. *Lygaeus guatemalanus* Distant

Intercepted at Washington, D.C., on *Cattleya* sp. from Venezuela.

18. *Clerada apicicornis* Signoret

Intercepted at Washington in orchid debris from Colombia; in New Jersey on *Cattleya* sp. from Colombia and Venezuela.

19. *Orthaea pallicornis* (Dallas)

Intercepted in California on *Vanda sanderiana* from the Philippines.

20. *Orthaea vicinalis* (Distant)

Intercepted at Washington on *Cattleya* sp. from Colombia.

21. *Cryphula affinis* (Wolff)

Intercepted at Washington, D.C., on *Cattleya* from Mexico.

22. *Cryphula apicatus* (Distant)

Intercepted in California on orchid from Mexico; in New Jersey on *Cattleya* sp. from Venezuela.

23. *Cryphula fasciatus* (Distant)

Intercepted in New Jersey on *Cattleya* sp. from Colombia.

24. *Antilocoris delineata* (Walker)

Intercepted at Washington, D.C., on *Cattleya* sp. from Colombia.

25. *Antilocoris picturata* (Blanchard)

Intercepted in California on *Cattleya skinneri* and *Oncidium splendidum* from Guatemala.

26. *Xestocoris collinus* (Distant)

Intercepted at Honolulu on *Stanhopea* from Canal Zone; at Washington, D.C., on *Oncidium* sp. from Guatemala; in New Jersey on *Cattleya bowringiana* from Guatemala.

27. *Ligyrocoris abdominalis* (Guerin)

Intercepted at Washington, D.C., on orchid from Guatemala.

28. *Ligyrocoris aurivilliana* (Distant)

Intercepted in Texas on orchid from Mexico.

29. *Ligyrocoris nitidicollis* (Stål)

Intercepted in Texas on orchid from Mexico.

30. *Ligyrocoris oblitus* Distant

Intercepted at Washington, D.C., on *Oncidium* sp. from Guatemala.

31. *Prytanis globosus* Distant

Intercepted in California on *Cattleya trianaei* from Colombia.

32. *Neocattarus vegetus* Distant

Intercepted at Washington, D.C., on orchid from Honduras; in Texas on orchid from Mexico.

33. *Exptochiomera minima* (Guer.)

Intercepted in California on *Laelia* sp. from Mexico.

34. *Exptochiomera formosa* (Distant)

Intercepted at Washington, D.C., on *Cattleya* sp. from Venezuela.

35. *Exptochiomera oblonga* (Stål)

Intercepted in New Jersey on *Cattleya* sp. from Venezuela.

36. *Exptochiomera tumens* (Stål)

Intercepted in New Jersey on *Cattleya* sp. from Venezuela.

37. *Melanocoryphus vittiscutis* (Stål)

Intercepted in Texas with orchid from Guatemala. Intercepted at Washington, D.C., in orchid packing from Guatemala.

38. *Myodocha intermedia* Distant

Intercepted in Texas on *Cattleya skinneri* from Mexico.

39. *Myodocha unispinosa* Stål

Intercepted in Texas on orchid from Mexico.

## PYRRHOCORIDAE

40. *Gonatas typicus* Distant

Intercepted in New Jersey on *Cattleya* sp. from Colombia.

## TINGITIDAE

41. *Phatnoma varians* Drake

Intercepted in California on *Cattleya schroederiana* from Colombia.

42. *Phatnoma annulipes* Champion

Intercepted at Washington, D.C., in orchid packing from Venezuela.

43. *Monanthia monotropidia* Champion

Intercepted in Texas on orchid from Mexico.

44. *Leptobyrsa plicata* Champion

Intercepted at Washington, D.C., on *Cattleya dowiana aurea* from Costa Rica.

## ARADIDAE

45. *Neuroctenus litigiosus* (Stål)

Intercepted in Texas on orchid from Guatemala.

## MIRIDAE

46. *Eurycipitia splendens* (Distant)

Intercepted at Washington, D.C., on *Cattleya* sp. from Colombia.

47. *Neella floridula* (Distant)

Intercepted at Washington, D.C., on *Cattleya* sp. from Colombia, and on *Epidendrum aromaticum* from Nicaragua.

48. *Fulvius quadristillatus* (Stål)

Intercepted at Washington, D.C., on orchid from Colombia; in New Jersey on *Cattleya* sp. from Colombia; in California on orchid from Brazil.

49. *Phytocoris militaris* Westwood

Has been reported on *Dendrobium* and *Phalaenopsis* in Java. (Possibly a synonym of *Tenthecoris bicolor*.)

A few other bugs have been similarly reported but without specific determination.

## HOMOPTERA

## APHIDIDAE

1. *Cerataphis lataniae* (Boisduval)

*Coccus lataniae* Boisduv., Ent. Hort., 1867.

*Cerataphis lataniae*, Swain, Univ. Cal. Pub. Ent., 3: 140, 1919.

This peculiar aphid commonly infests orchids, but has other host plants besides as palms and ferns. It is known in Honolulu, and has been found on orchids in greenhouses. It has widespread distribution, occurring on several orchids, and has been frequently intercepted at Honolulu on imported orchids. Intercepted in California on orchids from New Jersey, Guatemala, Brazil, Belgium, England and Manila. The immature aphids resemble aleurodids, being black and oval in shape, with a white waxy fringe. They locate on either surface of the leaves and suck the sap. Vanilla plantations are attacked in Reunion.

## 2. *Macrosiphum luteum* (Buckton)

*Siphonophora lutea* Buckton, British Aphides: 119, pl. 8, 1876.

*Macrosiphum luteum*, Bates, Bol. Agric. y Caminos, Guatemala, 10 (3): 101-104, 3 figs., 1931.

This aphid was described in England from several kinds of orchids in hothouses. It has been intercepted many times at mainland stations on orchids from Central and South America. Intercepted at Washington, D.C., on orchid from England, on orchid from Bolivia, on *Oncidium sphacelatum* from Costa Rica, on *Cattleya aurantiaca* and *Lycaste* sp. from Guatemala, on orchid from Mexico; at Honolulu on *Oncidium sphacelatum* from Guatemala; in California on *Lycaste skinneri*, *Oncidium sphacelatum*, *Brassia verrucosa*, *Epidendrum vitellium*, *Oncidium cavendishianum*, *Cattleya skinneri*, *C. bozwingiana* and *Epidendrum stamfordianum* from Guatemala, on *Oncidium bicallosum*, *Laelia anceps*, *Odontoglossum citrosum*, *Epidendrum* sp., *Laelia autumnalis albiflora* and *Catasetum* sp. from Mexico; in Texas on orchid from Mexico and on orchid from Costa Rica; in Puerto Rico and Florida on orchid from Venezuela; in New York on *Cattleya mossiae* var. from Venezuela.

## 3. *Aphis gossypii* Glover

The cotton aphid sometimes infests the flowers of orchids in Honolulu.

## 4. *Macrosiphum orchidacearum* van der Goot

## 5. *Macrosiphum polystachyae* van der Goot

Franssen en Tiggelevend, Insects and diseases of orchids in Java: 19, 1935.

These two aphids occur on *Dendrobium* spp. in Java. Colonies of them infest the flower stalk and buds. I have seen no other record of their occurrence.

## ALEURODIDAE

## 1. *Dialeurodes citri* (Riley & Howard)

*Aleyrodes citri* R. & H., Insect Life, 5: 219, figs. 23, 24, 1893.

*Dialeurodes citri*, Cockerell, Proc. Ac. Sci. Phila., 1902: 283.

Has been intercepted at Washington, D.C., on *Oncidium carthaginense* from Costa Rica.

## 2. *Aleurodicus guppyi* Quaintance & Baker

U. S. D. A. Ent., Tech. Ser. 27 (1): 59, 1913.

Described from Trinidad. Not an orchid insect, but has been reported as intercepted on orchids from Central and South Amer-

ica. Intercepted at Washington, D.C., on orchids from Mexico and Guatemala.

#### PSYLLIDAE

##### ***Trioza litseae* Giard**

This is a psyllid which has been reported on orchids in Reunion, destroying the fruit. It occurs also on laurel.

#### MEMBRACIDAE

##### 1. ***Trachytalis isabellina* Fowler**

Intercepted in California on orchid from Mexico, on *Lycaste skinneri* from Guatemala.

##### 2. ***Aphetea inconspicua* Fowler**

Intercepted in California on orchid from Mexico.

#### COCCIDAE (Scale Insects)

##### LIST OF SCALE INSECTS FOR WHICH ORCHIDS ARE THE SOLE OR CHIEF FOOD PLANT

I have listed here twenty-nine species of scale insects for which orchids of one species or another are their favorite food plants, or in some cases probably their exclusive food plants. Quite a number of the species, as their specific names indicate, were named and described from orchids, and for which no other food plant has been recorded. In a few cases, there is no record except the initial one which happened to be an orchid. For some of these, perhaps additional observations may indicate other food plants. Of this list, six have been recorded on orchids in Hawaii at one time or another, though they may not all be permanently established. These include the following:

*Coccus pseudohesperidum*, *Diaspis boisduvalii*, *Furcaspis bififormis*, *Parlatoria pseudaspidotus*, *Parlatoria proteus*, *Leucaspis cockerelli*.

##### 1. ***Conchaspis angraeci* Cockerell**

Jour. Inst. Jamaica, 1: 256, 1893.

Described from a Madagascar orchid, *Angraecum eburneum* var. *virens*, at Hope Gardens, Jamaica. Also recorded in England on *Rodriguezia secunda*, on freshly imported plants from Trinidad.

At Washington, D.C., it has been intercepted on *Oncidium ampliatum* from Colombia, on *Oncidium* sp. from Mexico, on *Gongora maculata* and *Epidendrum elongatum* from Trinidad, on *Lockhartia pallida* from Canal Zone, on *Cattleya* sp. from Venezuela. Intercepted in California on orchid from Nicaragua, on *Epidendrum*

*hunterianum*, *E. rousseanae*, *Lockhartia lunifera*, *Oncidium stipitatum* and *Oncidium ampliolum* from Canal Zone. Intercepted at Honolulu on *Laelia* sp. and *Oncidium* sp. from Canal Zone. Intercepted at Puerto Rico on *Vanilla* from Ecuador. Intercepted in New Jersey on *Cattleya* sp. and *Oncidium* sp. from Brazil.

## 2. *Asterolecanium aureum* (Boisduval)

*Coccus aureus* Boisduval, Insectologie Agricole, 2: 301, 1868.

*Asterolecanium aureum*, Targ., Ann. Soc. Ent. France, (4) 10: 277, 1870.

In Europe, on imported orchids from the West Indies: *Calathea vittata* and *Oncidium*.

Intercepted at Washington, D.C., on *Cattleya* sp. from Colombia, on *C. guttata* from Brazil, on *Oncidium* sp. from Trinidad, on *Oncidium lucidum* from Jamaica, on *Angraecum eburneum* from British Guiana, on *Brassia caudata*, and *Epidendrum* sp. from Dominican Republic, on *Gongora atropurpurea* from Trinidad, on orchid from Venezuela, on *Brassavola nodosa* and *Oncidium* sp. from Costa Rica and Dominican Republic, on *Cattleya dowiana* and *Oncidium kramerianum major* from Costa Rica, on *Brassia* sp. from Dominican Republic, on *Laelia albida sulphurea* from Mexico, on *Epidendrum* sp. from Guatemala and Haiti. Intercepted in California on *Epidendrum* sp. from Guatemala, on *Cattleya labiata* from Brazil, on *C. trianaei* from Colombia, on *Oncidium kramerianum* from Costa Rica, on *Oncidium tigrinum* from Mexico, on *Oncidium* sp. from Trinidad. Intercepted at Honolulu on *Epidendrum truncatum* from Dominican Republic and *Gongora maculata* from Canal Zone. Intercepted at Puerto Rico on orchid from Venezuela. Intercepted in New Jersey on *Cattleya dowiana*, *Epidendrum ciliare* and *Trichopilia* sp. from Costa Rica.

## 3. *Asterolecanium epidendri* (Bouché)

*Lecanium epidendri* Bouché, Stett. Ent. Zeit., 5: 300, 1844.

*Asterolecanium epidendri*, Ckll., Proc. Acad. Nat. Sci. Phila.: 269, 1899.

Described in Germany on *Epidendrum cuspidatum* from the West Indies. It also infests *Oncidium tetrapetalum* and *Broughtonia sanguinea* in Jamaica, and *Angraecum sesquipedale*.

It has been intercepted in California on *Brassia gireoudiana*, *Cattleya dowiana* and *Gongora armeniaca* from Costa Rica, on *Cattleya luddemanniana* from Venezuela, on *Laelia superbians* from Guatemala, on *Odontoglossum grande* from Salvador, on *Cattleya* sp. from Brazil and Colombia; in New Jersey on *Brassia gireoudiana* and *Epidendrum ciliare* from Costa Rica, on *Cattleya* sp. from Brazil, Venezuela, Colombia and Costa Rica.

#### 4. *Lecaniodiaspis dendrobii* (Douglas)

*Prosopophora dendrobii* Dougl., Ent. Mo. Mag., 28: 207, 1892.

*Lecaniodiaspis dendrobii*, Ckll., Check List: 237, 1896.

Described from Demerara on *Dendrobium calceolaria*. It has been intercepted at Washington, D.C., on orchid from Venezuela; and at California on *Laelia rubescens* from Guatemala, and *Cattleya* sp. from Colombia; at New Jersey on *Cattleya* sp. from Venezuela.

#### 5. *Pseudococcus orchidicola* Takahashi

Takahashi, Tenthredo, 2 (3): 242, fig. 3, 1939.

Described from Rota, Mariana Islands, on an orchid. No other records found.

#### 6. *Vinsonia stellifera* (Westwood)

*Coccus stellifer* Westw., Proc. Ent. Soc., London, 1871: iii.

*Vinsonia stellifera*, Sign., Ent. Mo. Mag., 25: 152, 1888.

Described from *Cypripedium niveum* from Siam. It occurs also on *Broughtonia sanguinea* and on ferns, coconut, guava and other plants, and has been recorded from Ceylon, West Indies, South America, Central America and California.

Intercepted at Washington, D.C., on *Epidendrum atropurpureum* from Colombia, on *Stanhopea insignis* from Brazil, on *Laelia* sp. and *Oncidium* sp. from Canal Zone, on *Brassia caudata*, *Lycaste costata*, *Oncidium* sp. from Dominican Republic, on *Epidendrum coccineum* from Jamaica, on *Bifrenaria aurantiaca*, *Epidendrum oncidioides*, *Gongora maculata*, *Oncidium papilio* and *Stanhopea grandiflora* from Trinidad, on *Epidendrum* sp. and *Lycaste costata* from Dominican Republic, on *Broughtonia sanguinea*, *Epidendrum fragrans* and *Phaius grandifolius* from Jamaica, on *Brassia verucosa*, *Stanhopea* sp. and *Epidendrum atropurpureum* from Panama, on *Spathoglottis* sp. from Ceylon, on *Oncidium kramerianum* from Canal Zone, on *Brassia* sp. from Dominican Republic, on *Oncidium* sp. from Guadeloupe, on *Catasetum* sp. from Venezuela. Intercepted in California on *Eria floribunda* from Borneo, on *Cattleya forbesi* from Dominican Republic, on *Aspasia* sp. from Panama, on *Lycaste* sp. from South America, on *Phalaenopsis amabilis* and *P. grandiflora* from Straits Settlements, on *Peristeria alata*, *Brassavola* sp., *Brassia* sp., *Cattleya* sp. and *Stanhopea bucephalus* from Canal Zone, on *Cypripedium philippinense* from Thailand, and on orchids from Mexico. Intercepted at Honolulu on *Epidendrum stamfordianum* from Canal Zone, on *Oncidium papilio* from British West Indies. Intercepted at Puerto Rico on orchid from the Virgin Islands, on orchid from Venezuela. Intercepted in Florida on *Oncidium altissimum* from the Virgin Islands.

#### 7. *Lecanium angraeci* (Boisduval)

*Chermes angraeci* Boisduval, Ent. Hort.: 337, 1867.

*Lecanium angraeci*, Sign., Ann. Soc. Ent. France, (5) 6:609, 1876.

Found on *Angraecum sesquipedale* from Madagascar. No other record of locality.

#### 8. *Coccus pseudohesperidum* (Cockerell)

*Lecanium pseudohesperidum* Ckll., Am. Nat., 29:380, 1895.

*Coccus pseudohesperidum*, Weiss, Psyche, 23:23, 1916.

Described from *Cattleya* in greenhouse in Canada. It occurs in greenhouses in New Jersey. At Honolulu, it has been intercepted a number of times on *Cattleya* sp. from New Jersey. Some orchid houses in Honolulu have had infestations of this scale, which is very injurious. Intercepted in California on orchids from Belgium.

#### 9. *Leucaspis cockerelli* (de Charmoy)

*Fiorinia cockerelli* de Charmoy, Pr. Soc. Amic. Scien.:33, 1899.

*Leucaspis cockerelli*, Fullaway, Proc. Haw. Ent. Soc., 10:46, 1938.

Recorded on orchids in Honolulu and Hilo in 1933. Intercepted in California on *Dendrobium thyrsiflorum* from Costa Rica, on *Epidendrum* sp. from Honduras. Intercepted at Washington, D.C., on *Vanda teres* from Jamaica, on *Epidendrum atropurpureum* and *Odontoglossum* sp. from Dominican Republic. Intercepted at Honolulu on *Spathoglottis* sp. from Fiji, on *Vanda luzonica* from Philippines. Intercepted in New Jersey on *Vanda teres* from Jamaica.

#### 10. *Diaspis boisduvalii* Signoret

Ann. Soc. Ent. France, (4) 9:432, 1869.

This scale occurs on orchids in many regions of the world. Its original habitat is uncertain. It occurs on some other plants also, as palms and hothouse plants. It has often been intercepted in shipments of imported orchids in California and Hawaii. It has been reported established in Hawaii, Australia, New Zealand, Canada, the eastern states, U.S.A., Mexico, Brazil, West Indies, Europe (in hothouses). No doubt, this is the scale recorded as *Diaspis* sp. in many interception records on orchids.

#### 11. *Diaspis cattleyae* (Cockerell)

*Aulacaspis cattleyae* Ckll., Biol. Centr.-Amer. 2 (2):30, 1899.

*Diaspis cattleyae*, Ckll., The Entomologist, 35:59, 1902.

As the name indicates, this scale was described from *Cattleya*. The specimens were on the leaves of a plant from Mexico, intercepted in California. Intercepted in Pennsylvania on *Odontoglossum* sp. from Mexico. It has also been intercepted in California on orchids from England. Intercepted at Honolulu on orchids from New Jersey.



12. *Phenacaspis dendrobii* Kuwana

Dobuts. Zasshi, Tokyo, 43: 657, figs., 1931.

Described on orchids entering Japan from Hong Kong. Intercepted at Honolulu on *Dendrobium draconis* from the Philippines.

13. *Pinnaspis townsendi* (Cockerell)

*Diaspis townsendi* Ckll., Biol. Centr.-Amer., 2 (2): 28, 1899.

*Hemichionaspis townsendi*, Fullaway, Proc. Haw. Ent. Soc., 10: 46, 1938.

*Pinnaspis townsendi*, U.S.D.A., List of Interceptions, 1941-42: 20, 1943.

Described from Mexico, on *Prosopis*. Listed by Fullaway as an orchid scale, often intercepted at Honolulu on orchids from the Philippines. Intercepted at Washington, D.C., on *Dendrobium* sp., *Vanda coerulea* and *Vanda* sp. from Siam, on *Rhynchostylis retusa* from Java. Intercepted at California on *Vanda* sp. from Guadeloupe and *Dendrobium phalaenopsis* from Sumatra. Intercepted at Honolulu on *Aerides falcatum*, *Aerides odoratum* and *Vanda roxburghi* from Thailand, on *Aerides lazerenciae*, *Aerides quinquevulnera*, *Aerides odoratum*, *Dendrobium moschatum*, *Renanthera storiei*, *Trichoglottis brachiata*, *Vanda luzonica*, *Vanda merrilli*, *Vanda tricolor*, *Dendrobium victoria-regina*, *Dendrobium aureum* and *Phalaenopsis amabilis rimestadiana* from the Philippines, on *Cymbidium* sp. from Japan, on *Vanda suavis* and *Aerides* sp. from Java.

14. *Aspidiotus cymbidii* Bouché

Stett. Ent. Zeit., 5: 296, 1844.

Described from *Cymbidium chinense* in greenhouses in Germany. No other record available.

15. *Aspidiotus australiensis* Kuwana

Dobuts. Zasshi, 43: 658, 1931.

Described from specimens intercepted in Japan on orchid from Thursday Island. I have found no other record.

16. *Aspidiotus biprominens* Kuwana

Dobuts. Zasshi, 43: 658, 1931.

Described from specimens intercepted in Japan on orchid from Java. No other records.

17. *Aspidiotus chinensis* Kuwana & Muramatsu

Journal Plant Prot., Tokyo, 18: 335, 1931.

Described from *Cymbidium faberi* intercepted in Japan from China. No other records.

18. *Hemiberlesia mendax* McKenzie

Bull. Dept. Agr. Calif., 32: 152, fig. 5, 1943.

Described from orchids from Guatemala intercepted in quarantine in California.

19. *Melanaspis aliena* (Newstead)

*Aspidiotus alienus* Newst., Ent. Mo. Mag., 37: 81, 1901.

*Melanaspis aliena*, U.S.D.A. Bur. Ent. and Plant Quar., List of Interceptions 1941-42: 17, 1943.

Described from *Cattleya skinneri*, under glass, London. It has been intercepted in California on *Cattleya bowringiana*, *C. skinneri*, *Oncidium altissimum* from Guatemala, on *Cattleya skinneri* from Costa Rica, on *Epidendrum radicans* and *E. macrocarpum* from Canal Zone, on *Brassavola glauca* from Mexico and on orchids from London. Intercepted in New Jersey on *Cattleya skinneri* alba from Costa Rica and *Odontoglossum* sp. from Mexico.

20. *Chrysomphalus odontoglossi* (Cockerell)

*Aspidiotus biformis* var. *odontoglossi* Ckll., Gard. Chron., (3) 13: 548, 1893.

*Chrysomphalus odontoglossi*, Fernald, Cat. Coccidae: 291, 1903.

On *Odontoglossum grande* in Jamaica. I found no record of other localities.

21. *Chrysomphalus nulliporus* McKenzie

Microentomology, 4: 76, fig. 35, 1939.

Described from *Dendrobium lyonii* from the Philippines, intercepted at San Francisco. It has also been intercepted at Honolulu on the same orchid from the Philippines. I have found no other record of this scale.

22. *Furcaspis biformis* (Cockerell)

*Aspidiotus biformis* Ckll., Gardener's Chronicle, (3) 13: 548, 1893.

*Furcaspis biformis*, Lindinger, Berlin, Ent. Zeit., 52: 99 (1907) 1908.

Described from Jamaica; also occurs in Trinidad, Antigua, Grenada and Central America. It has been found established in New Jersey greenhouses on orchids from Brazil and Venezuela. It has been intercepted in California on orchids from Chile and at Honolulu on orchids from New Jersey.

Intercepted at Washington, D.C., on *Cattleya superba* from British Guiana, on *Cattleya gigas*, *Oncidium luridum* and *Phaius* sp. from Jamaica, on *Cattleya* sp. from Venezuela, on *Brassia caudata*, *Epidendrum* sp., *Oncidium* sp., from Dominican Republic, on *Brassavola nodosa* and *Schomburgkia* sp. from Jamaica, on

*Cattleya labiata*, *C. mossiae*, *Epidendrum osmanthum*, *Oncidium altissimum* and *Schomburgkia lyonsii* from British Guiana, on *Oncidium* sp. from Costa Rica, on *Cattleya mantinii-nobilior* from Dominican Republic, on *Epidendrum atropurpureum* and *Oncidium* sp. from Panama and the Canal Zone, on *Epidendrum atropurpureum* from Costa Rica, on *Cattleya* sp. from Colombia, on *Cattleya* sp., *Oncidium sprucei* and *Schomburgkia crispa* from Trinidad, on *Oncidium* sp. from Guadeloupe.

Intercepted at Honolulu on *Oncidium panamense* and *Epidendrum* sp. from the Canal Zone, on *Epidendrum atropurpureum* from Panama, on *Epidendrum* sp. from Venezuela, on *Dendrobium* sp. from Burma, on *Oncidium luridum intermedium* from Dominican Republic, and on orchids from New Jersey and Manila.

Intercepted in California on orchid from the Dutch East Indies, on *Epidendrum atropurpureum* from Panama, on *Cattleya trianaei* from the Canal Zone and Colombia, on *Odontoglossum* sp. and *Oncidium panamense* from Panama, on *Oncidium sphacelatum*, from Straits Settlements, on *Oncidium confusum* from the Canal Zone, on *Cattleya gigas* and *Rodriguezia secunda* from Colombia, on orchids from Chile, on *Cattleya aurea*, *C. skinneri* and *C. trianaei* from Guatemala, on *Oncidium lanceanum* from Trinidad, on *Cattleya superba* from British West Indies, on *Laelia* sp. from Mexico, on *Cymbidium lowiana* from India.

Intercepted at Puerto Rico on *Oncidium carthaginense* from Dominican Republic, on orchid from Venezuela, on *Cattleya* sp. from Venezuela. Intercepted at New York on *Cattleya percivaliana* from Venezuela. Intercepted in New Jersey on *Brassavola nodosa*, *Brassia caudata*, *Epidendrum atropurpureum* from Canal Zone, on *Cattleya* sp., *Oncidium* sp., *Schomburgkia* sp. from Venezuela.

### 23. *Furcaspis biformis* var. *cattleyae* (Cockerell)

*Aspidiotus biformis* var. *cattleyae* Ckll., Gardener's Chronicle, (3) 13 : 548, 1893.

Described from Jamaica on *Cattleya bowringiana*. Intercepted in California on orchid from Jamaica.

### 24. *Lepidosaphes cymbidicola* Kuwana

Imp. Plant Quar. Serv. Tech. Bull. 2 : 27, pl. 8, figs. f-j, 1925.

Described from orchids in greenhouses in Yokohama and Kobe, Japan. Also intercepted in Japan on orchids from Formosa and China. Intercepted at Honolulu on *Cymbidium sinense* from Japan and on *C. powelli* from New Jersey.

### 25. *Lepidosaphes pinnaeformis* (Bouché)

*Aspidiotus pinnaeformis* Bouché, Stett. Ent. Zeit., 12 : 111, 1851.

*Lepidosaphes pinnaeformis*, Fernald, Cat. Coccidae : 313, 1903.

Described from the East Indies, on leaves of *Cymbidium olei-*

*folium*. Has been recorded on *Cymbidium pendulum* at the Kew Gardens.

**26. *Lepidosaphes tuberculata* Malenotti**

Redia, 12: 183, pl. 1, figs. 1-5, 1916.

Described in Italy from *Cymbidium tracyanum*. Has also been recorded in England on *Cymbidium* sp. Green suggests the likelihood of *tuberculata* being a synonym of *pinnaeformis*. Has been intercepted at Honolulu, and in California and New Jersey on *Cymbidium* sp. from England.

Intercepted at Washington, D.C., on *Cymbidium devonianum*, *C. erica*, *C. castor aureum*, *C. alexanderi*, *C. steffi* and *C. miranda* from England, on *Cymbidium* sp. from Dutch Guiana, on *Cymbidium pauwelsii* from Belgium, on *Cymbidium lowianum* from India. Intercepted at California on *Cymbidium* sp. from England and Japan, on *Cymbidium tracyanum* and *C. insigne* from Australia. Intercepted at Washington on *Cymbidium* sp. and on *Cymbidium gyrokuchen* from Japan. Intercepted at Honolulu on *Cymbidium lowianum* from Australia and *Cymbidium sinense* from Japan. Intercepted in New Jersey on *Cymbidium eburneum* from England.

**27. *Lepidosaphes mackieana* McKenzie**

Bull. Dept. Agric. Calif., 32: 153, fig. 6, 1943.

Described from *Dendrobium merlin* in orchid houses in California. It is known in orchid houses in New Jersey, and also is established in orchid houses in Honolulu. It has been intercepted in quarantine at Honolulu on *Dendrobium superbum dearei* from New Jersey; in California on *Dendrobium* sp. from Hawaii and New Jersey.

**28. *Parlatoria proteus* (Curtis)**

*Aspidiotus proteus* Curtis, Gardener's Chronicle, No. 39, 1843: 676.

*Parlatoria proteus*, Sign., Ann. Soc. Ent. France (4) 9: 450, 1869.

Described from scales on *Aloe* and *Amaryllis*. It is recorded on many other kinds of plants including orchids, and widely spread including Europe, Australia, China, Japan, Formosa, Hawaii, Brazil and the United States. Has been intercepted in California on orchids from the Orient. It has been intercepted at Honolulu, on orchids from the Philippines. It occurs on orchids in greenhouses in the eastern States, and has been recorded from Hawaii.

**29. *Parlatoria pseudaspidiotus* Lindinger**

Insekten Börse, 23: 131, 1905.

Described from Singapore on orchids. Also recorded in India.

Intercepted at Honolulu on *Vanda joaquimae* from Australia, on *Trichoglottis philippinensis*, *Vanda teres*, *V. hookeriana*, *Vanda teres alba*, *Vanda joaquimae* and several other orchids from the Philippines, on *Vanda* sp. from Java and Sumatra, on *Vanda teres andersoni* and *Vanda teres grandiflora* from Japan, on *Vanda cooperi* and *V. hookeriana* from Straits Settlements. Intercepted in California on *Vanda teres*, *V. joaquimae*, *V. lamellata* and *V. hookeriana* from the Philippines, on *Vanda* sp. from Straits Settlements, on *Vanda* sp. from Thailand, on *Vanda teres* from India. Intercepted at Washington, D.C., on *Vanda teres andersoni* and *Vanda teres aureorea* from India, on *Vanda teres* from Ceylon, on *Vanda teres* from Straits Settlements and from England, on *Vanda* sp. from Java, on *Dendrobium* sp. from Sumatra. It has been reported as occurring in Honolulu.

#### LIST OF SCALE INSECTS HAVING DIVERSE FOOD PLANTS, INCLUDING ORCHIDS

This long list of 78 species was chiefly obtained from the reports of the U. S. Bureau of Entomology and Plant Quarantine on insects found on imported orchids from various parts of the world. It includes species which have many food plants (polyphagous), and their occurrence on orchids might be considered casual, incidental or accidental. It may be that these imported orchids have been held for a time at the source, in plant houses associated with other kinds of plants from which they became infested. As no special study has been made on the occurrence of scales on orchids in their natural habitat, information on this point is very uncertain, and it is only a conjecture on my part that the orchids have become infested after having been brought in from the wild. Many of the species of this list are now so widely spread that it is not always certain what was their original home.

Many of the records of scale insects intercepted on orchids give the determinations only to the genus, as: *Aspidiotus* sp., *Saissetia* sp., *Pseudococcus* sp., and *Diaspis* sp. In these cases, no doubt, the scale insects really were of the same species of the respective genera which have been recorded as intercepted on orchids from the same regions at other times.

##### 1. *Icerya seychellarum* (Westwood)

Intercepted in California on orchids from Tahiti.

##### 2. *Icerya montserratensis* Riley & Howard

Intercepted at Washington, D.C., on orchid from Colombia.

##### 3. *Puto mexicanus* (Cockerell)

Intercepted in California on *Laelia anceps*, *Odontoglossum citrosimum*, *Oncidium* sp. and *Stanhopea* sp. from Mexico.

4. **Puto yuccae** (Coquillett)

Intercepted in California on *Oncidium* sp. from Mexico.

5. **Asterolecanium pustulans** (Ckll.)

Widely distributed in American Tropics. Occurs also in Hawaii, especially on fig and oleander. Reported as common on leaves of orchids in British Guiana.

6. **Ceroputo barberi** (Cockerell)

Intercepted at Honolulu on orchids from India.

7. **Ceroputo** sp.

Intercepted in California on orchids from Central America. Intercepted at Honolulu on *Oncidium papilio majus* from Trinidad.

8. **Pseudococcus brevipes** (Ckll.)

This is the notorious pineapple mealybug. It occurs on many other plants and is widely distributed in tropical regions. It is reported as an orchid pest in Java: on *Phalaenopsis amabilis*, *Dendrobium crumenatum* and *Vanda dearei*. Intercepted at Honolulu on *Phalaenopsis amabilis* from the Philippines.

9. **Pseudococcus citri** (Risso)

Another widely distributed polyphagous mealybug. Reported on the following orchids in Java: *Dendrobium crumenatum*, *D. phalaenopsis* and *D. veratrifolium*.

10. **Pseudococcus crotonis** Green

Intercepted in California on orchids from the Philippines.

11. **Pseudococcus glaucus** (Maskell)

Described in New Zealand, on several plants, including orchids in greenhouses.

12. **Pseudococcus kraunhiae** (Kuwana)

Intercepted in California on orchid from Hawaii.

13. **Pseudococcus longispinus** (Targioni)

Reported on orchids in Honolulu. Intercepted in California on orchids from Manila and Guatemala.

14. **Pseudococcus liliacinus** Cockerell

Intercepted in California on *Phalaenopsis amabilis* and *P. rimstadiana* from the Philippines, on *Phalaenopsis amabilis* from Sumatra. Intercepted at Honolulu on *Vanda coerulea* and *Phalaenopsis amabilis* from Sumatra, on *Vanda sanderiana*, *Aerides quinquevulnera*, and several other orchids from the Philippines.

15. **Pseudococcus maritimus** (Ehrhorn)

Intercepted at Honolulu on orchids from California, New Jersey, New York, and from India.

16. **Pseudococcus nipae** (Maskell)

Intercepted in New Jersey on *Odontoglossum* sp. from Costa Rica.

17. **Ferrisia virgata** (Cockerell)

Intercepted at Honolulu on *Dendrobium crumenatum* and several other orchids from the Philippines and on orchids from Singapore. Intercepted in California on *Phalaenopsis amabilis* from the Philippines. Intercepted at Washington on several kinds of orchids from the Philippines. Intercepted in New York on *Cattleya trianaei* from Colombia. Reported on *Dendrobium crumenatum* in Java.

18. **Pulvinaria floccifera** (Westw.)

The camellia scale has been reported on orchids in England: on *Oncidium papilio* and *Calanthe natalensis* in greenhouses. Intercepted at Washington, D.C., on *Dendrobium nobile-virginale* and *Odontonia olga* from England. Intercepted in New Jersey on *Cymbidium* sp. from England.

19. **Ctenochiton elongatus** Maskell

Described in New Zealand on *Geniostoma* and has also been found on an orchid (*Dendrobium*) in New Zealand.

20. **Eucalymnatus perforatus** (Newstead)

Described from a palm in greenhouse in England. Intercepted in California on orchids from New Jersey, New York, and England.

21. **Eucalymnatus tessellatus** (Signoret)

Has been intercepted a number of times in California on orchids from New York and New Jersey.

22. **Lecanium aequale** Newstead

Described from British Guiana, but not on orchids. Reported in 1924 as occurring on orchids in Honolulu.

23. **Lecanium elongatum** Signoret

Described from France. Sometimes on *Dendrobium*.

24. **Coccus acuminatus** (Sign.)

Sometimes found on orchids in greenhouses in France. Has been intercepted in California on orchids from Hawaii.

25. **Coccus hesperidum** Linnaeus

Has been recorded on orchids in greenhouses in New Jersey.

Has also been reported on orchids in Hawaii. It has been intercepted in California on orchids from New Jersey, New York, Guatemala, England and Belgium.

**26. *Coccus capparidis* (Green)**

Described in Ceylon from *Capparis*. Recorded from orchids in Hawaii. Intercepted in California on *Cypripedium villosum* and *C. fairieanum* from India.

**27. *Coccus viridis* (Green)**

Intercepted in California on *Cattleya* sp. from Panama.

**28. *Coccus longulus* (Douglas)**

Intercepted in California on orchids from New Jersey.

**29. *Saissetia filicum* (Boisduval)**

As the name indicates, this scale was described from ferns. It was once intercepted at Honolulu on orchids from New Jersey.

**30. *Saissetia hemisphaerica* (Targ.)**

Occasionally occurs on orchids in Hawaii; also reported on orchids in California. Found on leaf of a ground orchid in New Caledonia by F. X. Williams. Intercepted in California on orchids from Mexico, New Jersey, New York and Manila. Intercepted at Honolulu on orchids from Manila.

**31. *Saissetia hemisphaerica hibernaculorum* (Boisduval)**

Occurs on many plants including greenhouse plants. Recorded on *Phaius* in Europe.

**32. *Saissetia oleae* (Bernstein)**

Intercepted in California on orchids from Manila.

**33. *Diaspis echinocacti* (Bouché)**

Intercepted in California on orchids from South America, and from Massachusetts.

**34. *Chionaspis graminis* Green**

Described from lemon-grass in Ceylon. It occurs on the leaves of *Dendrobium crumenatum* growing wild in Java.

**35. *Hemichionaspis minor* (Maskell)**

Intercepted in California on orchids from Panama.

**36. *Pinnaspis aspidistrae* (Sign.)**

Intercepted in California on orchids from New York and also from England. Has been recorded on orchids in Hawaii. Intercepted at Honolulu on orchids from Australia.



37. *Pinnaspis buxi* (Bouché)

Is mostly a palm pest, but has been recorded on orchids in Hawaii. Intercepted in California on orchid from Dominican Republic.

38. *Fiorinia fiorinae* (Targioni)

Mostly a palm pest, but has been recorded on orchids in New Jersey greenhouses. Intercepted at Honolulu on orchids from Java.

39. *Fiorinia stricta* Maskell

Described in New Zealand on *Dendrobium*, and also other plants.

40. *Aspidiotus britannicus* Newstead

Described on holly in England. Has been intercepted in California on orchids from New York.

41. *Aspidiotus cyanophylli* Sign.

Reported on orchids, palms and ferns in New Jersey greenhouses. Has been intercepted in California on orchids from New Jersey, New York and Mexico, and intercepted at Honolulu on orchids from Panama and New Jersey.

42. *Aspidiotus destructor* Sign.

This is the devastating coconut pest in some Pacific regions. It has been intercepted at Honolulu on orchids from the Philippines.

43. *Aspidiotus diffinis* Newstead

Described from Demerara. Host plant not known. Intercepted at Honolulu on *Oncidium pusillum* from Canal Zone. Intercepted at Washington, D.C. on *Cattleya gigas sanderiana* from Colombia.

44. *Aspidiotus hederae* (Vallot)

The oleander scale. It has a very extensive distribution and a very wide range of food plants. Has been reported on orchids in New Jersey and California greenhouses. Has been intercepted in California on orchids from Rhode Island and New Jersey.

45. *Aspidiotus excisus* Green

Intercepted at California on *Cypripedium suavissimum* from India.

46. *Aspidiotus latastei* Cockerell

Intercepted at Washington, D.C. on orchid from Brazil.

47. *Aspidiotus coloratus* Cockerell

Described from New Mexico on *Chilopsis*. Reported on *Cattleya citrina*.

48. *Aspidiotus lataniae* Signoret

Intercepted in California on orchids from Brazil; at Honolulu on orchids from the Philippines.

49. *Aspidiotus palmae* Morgan

Described from Jamaica on coconut leaves. Fullaway has listed it among scales occurring on orchids. Intercepted at Washington, D.C., on *Stanhopea* sp. from Colombia.

50. *Aspidiotus spinosus* Comstock

Described from *Camellia* in Washington greenhouse. Listed by Fullaway among scales occurring on orchids. Intercepted in California on *Dendrobium superbium* from the Philippines. Intercepted at Washington, D.C., on *Lycaste* sp. from Colombia.

51. *Morganella longispina* (Morgan)

Described from Demerara, on *Cupania sapida*. Has been intercepted in California on *Dendrobium spectabile* from Australia; and on *Grammatophyllum speciosum* from the Philippines.

52. *Pseudaonidia curculiginis* Green

Described from Java on an amaryllid. Has been intercepted in California on orchids from the Philippines. Intercepted at Honolulu on *Vanda teres* and *Grammatophyllum speciosum* from the Philippines. Intercepted at Washington, D.C. on *Cymbidium finlaysonianum* from the Philippines.

53. *Pseudaonidia tesserata* (de Charmoy)

Intercepted at Honolulu on *Vanda suavis* from Australia. Intercepted at Washington, D.C. on *Cattleya* sp. from Colombia; in California on orchid from Nicaragua.

54. *Pseudaonidia clavigera* Cockerell

Intercepted in California on orchid from Australia.

55. *Pseudaonidia trilobitiformis* (Green)

Intercepted at Washington, D.C. on *Sobralia* sp. from Brazil.

56. *Chrysomphalus aonidum* (Linnaeus)

Has a world-wide distribution, and an extensive range of food-plants. Has been intercepted in California on orchids from Guatemala, Manila and New Jersey. Has been recorded on orchids in conservatory in San Francisco, California.

57. *Chrysomphalus aurantii* (Maskell)

Also has a wide range geographically, and as to food-plants. Has been intercepted in California on orchids from Hawaii.

58. **Chrysomphalus dictyospermi** (Morgan)

Described from Demerara on palm. Has been intercepted in California on orchids from New Jersey, Guatemala, Venezuela and Chile. Intercepted at Honolulu and in Texas on *Odontoglossum citrosimum* from Mexico. A variety was intercepted at Honolulu on *Staurochilus davisii* from the Philippines. Intercepted at Washington, D.C., on *Epidendrum* sp. from Mexico and on *Dendrobium draconis* from Burma. The variety *arecae* has been reported on orchids in conservatory in San Francisco.

59. **Chrysomphalus dictyospermi arecae** (Newstead)

This variety has been found on orchids in Golden Gate Park, San Francisco. It is also recorded on *Cypripedium* and *Dendrobium* in greenhouses in England.

60. **Chrysomphalus nigropunctatus** (Cockerell)

Intercepted in Texas on orchid from Mexico.

61. **Chrysomphalus obscurus** (Comstock)

Has been recorded on *Laelia albida*, but it occurs mostly on other plants.

62. **Chrysomphalus perseae** (Comstock)

Recorded on orchids in New Jersey greenhouses. Also intercepted in New Jersey on orchids from Central America. Intercepted in California on orchids from Colombia.

63. **Chrysomphalus rossi** (Maskell)

Reported on orchids in Hawaii. It is recorded in New Jersey greenhouses on orchids from the Philippines. Intercepted at Honolulu on *Phalaenopsis mariae*, *P. schilleriana*, *P. amabilis*, *P. leucorrhoda* and *Vanda boxallii* from the Philippines; on *Dendrobium superbiens* from Australia; on *Ionopsis satyrioides*, *Oncidium luridum intermedium* and *O. variegatum* from Dominican Republic. Intercepted in California on *Phalaenopsis schilleriana*, *P. aphrodite* and *P. amabilis* from the Philippines.

64. **Chrysomphalus scutiformis** (Ckll.)

Described from Mexico, without record of food-plant. Has been intercepted in California on orchids from New Jersey.

65. **Chrysomphalus umboniferus** (Newstead)

Described from Guiana on *Lecythis* (not an orchid). Has been intercepted in California on *Epidendrum stanfordianum* from Costa Rica, *Laelia* sp. from Venezuela and *Oncidium sphacelatum* from Guatemala; at New York on *Cattleya* sp. from the Canal Zone.

66. **Aonidiella eremocitri** McKenzie

This scale was described from Australia. It has been intercepted at Honolulu on *Coelogyne asperata* from Thailand.

67. **Pseudischinaspis bowreyi** (Cockerell)

Intercepted at Honolulu on *Oncidium ampliatus* from the Canal Zone. Intercepted at Washington, D.C. on *Cattleya skinneri* and *Epidendrum costaricensis* from Dominican Republic.

68. **Pseudoparlatoria ostreata** Cockerell

Described from Jamaica. Listed by Fullaway as incidental on orchids. Intercepted at Washington, D.C. on *Epidendrum christi* and *Oncidium henckenii* from Dominican Republic. Intercepted at Honolulu on *Laelia superbiens* from Guatemala. Intercepted at Puerto Rico on *Cattleya* sp. from Venezuela.

69. **Pseudoparlatoria parlatorioides** (Comstock)

Described from Florida. Has been reported on a variety of plants, among them *Oncidium varicosum*. Intercepted at Washington, D.C. on *Cypripedium* sp. from England, on orchid from Honduras, on *Cypripedium clinkaberryanum* and *Brassavola* sp. from Peru. Intercepted in California on *Laelia autumnalis* from Trinidad. Intercepted at Washington, D.C. on *Lycaste* sp. Intercepted at Puerto Rico on *Cattleya gaskelliana* and *C. mossiae* from Venezuela.

70. **Lepidosaphes chinensis** Chamb.

Described from Canton, China, on "magnolia". Has been found on *Cymbidium* sp. in a California greenhouse.

71. **Lepidosaphes tubulorum**

Intercepted at Washington, D.C., on *Cymbidium* sp. from England.

72. **Lepidosaphes beckii** (Newman)

Intercepted in California on orchids from Ceylon.

73. **Lepidosaphes cocculi** (Green)

Intercepted in California on orchids from Manila; at Honolulu on orchid from China and on *Dendrobium* from Manila.

74. **Lepidosaphes pallida** (Green)

Intercepted in California on orchid from Java.

75. **Lepidosaphes** sp.

An undetermined, apparently new species, has been found infesting orchids in Honolulu.\*

\*See p. 219, this issue.

76. *Parlatoria pergandii* Comstock

Intercepted in California and at Honolulu on orchids from Manila. Also recorded on orchids in conservatory in San Francisco.

77. *Parlatoria mangiferae* Marlatt

Described from mango leaves in U.S.D.A. greenhouses, Washington, D.C. Also recorded from Singapore. Intercepted in Japan on orchids from Malaya. Intercepted in California on orchids from Singapore and Manila.

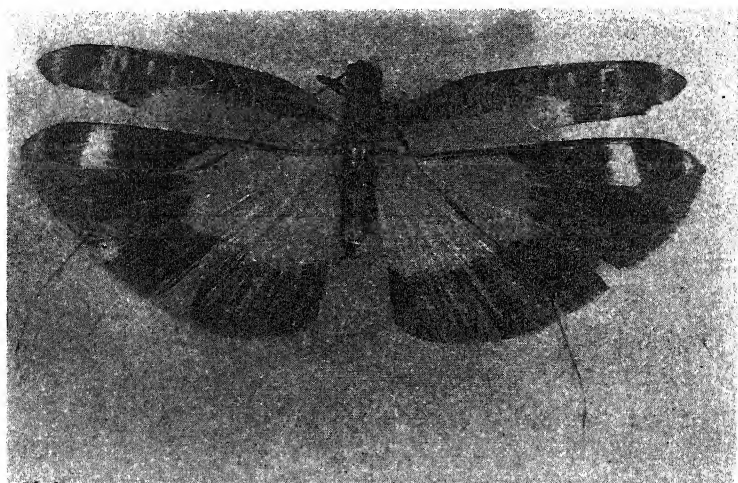


Fig. 1. *Harroweria gloriosa* Hebard, male,  $\times 1.2$ .

78. *Parlatoria mytilaspiformis* Green

Described from Ceylon, on *Psychotria*. Has been recorded on orchids in Hawaii. Intercepted in California on *Aerides* sp. from the Philippines.

## ORTHOPTERA

### TETTIGONIIDAE

*Harroweria gloriosa* Hebard (fig. 1)

Trans. Am. Ent. Soc., 53: 89, pl. 18, fig. 2, 1927.

This attractive katydid gained admission to Honolulu under interesting circumstances, which it is well to relate, although the evidence does not convict it of being a real pest of orchids. On March 20, 1933, Dr. Lyon found peculiar katydid-like insects hatch-

ing from the thick leaf of an *Oncidium stipitatum*, which he had received from Panama about seven months previously. Being different from any known insect in Hawaii, these young insects were carefully retained in the quarantine room at the Experiment Station, H.S.P.A., as was also the leaf cut from the orchid. A total of 28 hatched from the leaf during about three weeks. The scars made where eggs had been inserted in the leaf were so obscure as to have escaped notice until hatching began, on the date mentioned above. The young insects were tried on various plant food, including orchid flowers, and it was found that their choice was canna flowers. Accordingly, they were reared on this diet, and fourteen katydids matured in the course of about two months. Being an entirely unknown insect, specimens were sent for determination to Morgan Hebard at the Academy of Natural Sciences, Philadelphia, who recognized it as the species *Harroweria gloriosa*, which he had previously described from a single specimen collected at Gatun, Canal Zone, in 1916. Apparently, the only association of this insect with the orchid, was a convenient and appropriate place for inserting its eggs. Any fleshy plant might have served the same purpose. This demonstrates the possibilities of insects smuggling in, in orchid plants, and the necessity of utmost precautions in the importing of orchid plants.

### **Sexava nubila (Stål)**

*Moristus nubilus* Stål, Recensia Orthopterorum, 2: 96, 1874.

*Sexava nubila*, Kirby, Cat. Orthoptera, 2: 359, 1906.

### **Sexava novae-guineae (Brancsik)**

*Moristus novae-guineae* Brancsik, Jahresh. Ver. Trencsen., 19: 81, 1897.

*Sexava novae-guineae*, Kirby, Cat. Orthoptera, 2: 359, 1906.

These two tettigoniids are pests of coconut trees in New Britain. They oviposit frequently in fleshy plant tissues, and it has been suggested that this pest may be spread by their eggs, having been laid in fleshy leaves of orchids growing as epiphytes on coconut trunks. Thus, these eggs might be carried to other regions in imported orchids from New Britain, similarly to the incident of *Harroweria gloriosa* detailed above.

### **Elimaia punctifera (Walker)**

*Phaneroptera punctifera* Walker, Cat. Derm. Salt. B.M., 2: 342, 1869.

*Elimaia punctifera*, Kirby, Cat. Orthoptera, 2: 396, 1906.

This large species has been reported ovipositing in orchid leaves occasionally in Honolulu.

**Tachycines asynamorus** Adelung

Annuaire Mus. Zool., St. Petersburg, 7: 56, 1902.

Reported to sometimes injure flowers and young leaves of orchids in Russia.

## LOCUSTIDAE

**Valanga nigricornis** (Burmeister)

*Acridium nigricorne* Burm., Handb. Ent., 2: 629, 1838.

*Valanga nigricornis*, Leefmans, Bandoeng, N.V. Mij. Vorkink, 1931.

This large grasshopper feeds destructively on the leaves and flowers of several kinds of orchids in Java: *Vanda*, *Phalaenopsis*, *Liparis* and *Dendrobium*. This would naturally be only in the open. Plants in orchid houses would not be subject to their depredations.

## GRYLLIDAE

**Gryllodes sigillatus** (Walker)

Intercepted at Honolulu in orchid debris from the Philippines, and orchid packing from England; at Washington, D.C., with orchids from the Canal Zone.

## PHASMIDAE

**Carausius morosus** Brunner

This walking stick insect was described from India and has been recorded as eating leaves of orchids there.

## DERMAPTERA

1. **Forficula auricularia** Linnaeus

This earwig has been occasionally observed on orchids, especially on the young leaves and flowers. Intercepted at Washington, D.C. on orchid from Brazil.

2. **Skalistes vidua**

Intercepted at Washington, D.C. on orchid from Guatemala.

3. **Eparchus cruentatus** Burr

Intercepted at Honolulu in orchid packing from the Philippines.

4. **Labia curvicauda** (Motschulsky)

Intercepted at Honolulu in orchid debris from the Philippines.

5. **Chelisoches morio** (Fabricius)

Intercepted in California with orchids from the Dutch East Indies and New Guinea.

## ROACHES

The following four roaches have been reported as occasional minor pests on orchids:

1. *Blatta orientalis* Linnaeus
2. *Periplaneta americana* (Linnaeus)
3. *Pycnoscelus surinamensis* (Linnaeus)
4. *Blaberus discoidalis* Serville
5. *Graptoblatta notulata* (Stål)

This last roach has been intercepted at Honolulu on orchids from India.

## THYSANOPTERA (Thrips)

At least twenty species of thrips have been found associated with orchids, chiefly in the buds and flowers. Only a few of them are of much importance, however, the greater number of them having been intercepted on imported orchids from various regions. Several have been described from orchids and named accordingly. A few others use orchids as their favored food plant. In Hawaii, four species have been troublesome in orchid houses: *Chaetanaphothrips orchidii* (Moulton), *Taeniothrips xanthius* (Williams), *Hercothrips femoralis* (Reuter) and *Heliothrips haemorrhoidalis* (Bouché).

## THRIPS DESCRIBED FROM ORCHIDS

1. *Anaphothrips orchidaceus* Bagnall

Ent. Mo. Mag., 45: 33, 1909.

Described from hothouse orchids in England and Ireland: *Odon-toglossum*, *Cypripedium*, *Zygopetalum*. It is known as the yellow orchid thrips, and is quite injurious. It has been intercepted at Washington, D.C. on *Miltonia* sp. from England; at Honolulu on *Phaius ashworthianus* and *Miltonia* sp. from England, *Cymbidium* sp. from Belgium and on orchids from Mexico; in California on *Laelia* sp. from Mexico, on *Cattleya mendelli* from Peru, on *Mil-tonia pulchra* and *Odontoglossum* sp. from England; in Texas, on orchids from Mexico, Colombia and Costa Rica; in Florida, on orchid from Colombia.

2. *Anaphothrips orchidearum* Bondar

Chacaras e Quintaes, S. Paulo, 44: 435, 1931.

Described from Bahia on leaves and flowers of *Coryanthes*, *Cyrtopodium*, *Catasetum* and *Miltonia*. I found no other locality record for it.



### 3. *Anaphothrips corbetti* Priesner

Proc. Royal Ent. Soc., London, (B), 5: 209, 1936.

Described from flowers of *Vanda Miss Joaquim* in Malaya. I found no other locality record for it.

### 4. *Chaetanaphothrips orchidii* (Moulton)

*Euthrips orchidii* Moulton, U.S.D.A., Ent. Tech. Ser., 12: 52, 1907.

*Chaetanaphothrips orchidii*, Bailey, Pan-Pacific Ent., 11: 166, 1935.

Described from orchids in greenhouse in California. Has been reported also destructive to *Cypripedium* spp. in greenhouses at Washington, D.C., and Louisville, Kentucky. Intercepted at Washington, D.C. on *Odontonia tyana argus* from England, and in California on orchid from Dominican Republic and on *Cypripedium curtisi* from Australia. It occurs in orchid houses in Honolulu, being first reported in 1929. It is also recorded on *Anthurium* and *Commelina nudiflora*; and on orange, grapefruit and tangelo in Florida.

### 5. *Gynaikothrips orchidis* Moulton

Bull. Brooklyn Ent. Soc., 22: 200, 1927.

Described on a single specimen from an orchid in Manila. I have found no other record of it.

### 6. *Heliothrips errans* (Williams)

*Heliothrips errans* Williams, Entomologist, 49: 243, 1916.

*Heliothrips errans*, Hood, J. Ent. Soc., S. Africa, 3: 41, 1940.

Described from *Laelia anceps* in greenhouse in England. Has been intercepted at Washington, D.C. on *Cypripedium* sp., *Cattleya bertheuana* and *Laeliocattleya soulange* x *Cattleya wottersiana* from England.

### 7. *Taeniothrips xanthius* (Williams)

*Physothrips xanthius* Williams, Bull. Ent. Research, 8: 59-61, fig., 1917.

*Taeniothrips xanthius* Watson, Bull. 168, Florida Exp. Sta.: 42, 1923.

Described on *Cattleya* from Trinidad where it damages the leaves of *Cattleya* and other orchids. It is a pest in orchid houses in Honolulu where it was first recorded in 1935.

### 8. *Dichromothrips orchidis* Priesner

Described from Burma. In greenhouse, brought in with *Dendrobium thyrsiflorum*.

THRIPS INCIDENTALLY ON ORCHIDS OR INTERCEPTED  
ON IMPORTED ORCHIDS

1. **Chirothrips falsus** Priesner

Described from Mexico. Has been intercepted in Texas on orchids from Mexico.

2. **Scirtothrips longipennis** (Bagnall)

Described on palm in Belgium. Has been intercepted on *Cypripedium* sp. at Honolulu from England.

3. **Heliothrips haemorrhoidalis** (Bouché)

A general feeder. Has been reported on orchids in Honolulu, and on *Cattleya* in California.

4. **Hercinothrips femoralis** (Reuter)

On several plants. In the States called the sugar beet thrips. Has been recorded on orchids in greenhouses in Honolulu, the first record being 1935. Intercepted at Honolulu and in New Jersey on *Cypripedium* from England.

5. **Parthenothrips dracaenae** (Heeger)

Described from *Dracaena*, and occurs also on palms. Has been intercepted at Washington, D.C. on *Cypripedium* sp. from England, and *Laeliocattleya britannia alba* from France. Intercepted at Honolulu on *Sobralia colmanae* from England.

6. **Frankliniella fortissima** Priesner

Described from Mexico. Has been intercepted in Texas on orchid from Colombia.

7. **Kakothrips pisivora** (Westwood)

The pea thrips described in England. Has been recorded on *Orchis* in Galicia.

8. **Taeniothrips smithi** (Zimmerman)

Described from Java. Has been reported in flowers of orchids in Formosa.

9. **Hoplandrothrips nigricestus** Hood

Described from dead leaves, Canal Zone. Has been intercepted at Washington, D.C. on orchid from Colombia.

10. **Hoplandrothrips reynei** (Priesner)

Described from a palm in Surinam. Has been intercepted in California on *Cattleya dowiana* from Colombia.

11. **Liothrips vaneeckei** Priesner

Described from the Netherlands. Has been intercepted at Wash-

ington, D.C. on lily bulbs from various European countries and on *Vanda roxburghii* from Ceylon.

12. **Haplothrips melaleuca** (Bagnall)

Described from a cruciferous plant in palm house in Denmark. Has been intercepted at Honolulu on *Renanthera monachica* from the Philippines.

13. **Haplothrips gowdeyi** (Franklin)

Has been reported feeding in orchid flowers in Honolulu.

14. **Frankliniella**, near **sulphurea** Schmutz

Has been reported feeding in orchid flowers in Honolulu.

15. **Thrips hawaiiensis** (Morgan)

Has been reported feeding in orchid flowers in Honolulu.

16. **Selenothrips indicus** (Bagnall)

Intercepted at Honolulu on orchids from India.

17. **Dichaetothrips williamsi** Karny

Described from Guatemala with no mention of host plant. Has been intercepted at Honolulu on *Oncidium splendidum* from Guatemala.

Besides those listed, there have been many interceptions of thrips on orchids from various regions, with incomplete determinations, the records being merely as *Liothrips* sp., *Frankliniella* sp., etc. Intercepted thrips on orchids with such incomplete records have been recorded in the following genera which are not in the above lists: *Aleurodothrips*, *Allothrips*, *Amblythrips*, *Brachythrips*, *Dicaiothrips*, *Glaucothrips*, *Hoplothrips*, *Hindsiana*, *Neophysopus*, *Physopus*, *Oxythrips*, *Phloeothrips*.

## EMBIOPTERA

Several species of embiids have been recorded as injurious to the roots of orchids in greenhouses, but they are not exclusively orchid insects. Of those listed below, only the first one occurs in Hawaii, and it is not here reported injurious to orchids.

1. **Oligotoma saundersii** (Westwood)

Has been reported injurious to *Phalaenopsis amabilis* in Java, causing a failure to flower.

2. **Oligotoma vossleri** Krauss

Causing injury similar to the above; also in Java.

### 3. *Oligotoma michaeli* McLachlan

Recorded from London as injuring roots of orchids in green-houses.

### 4. *Oligotoma trinitatis* (Saussure)

Observed in Trinidad, injuring roots of orchids.

### 5. *Antipaluria urichi* (Saussure)

Observed also injuring roots of orchids in Trinidad.

## ISOPTERA

### 1. *Nasutitermes cornigera* (Motschulsky)

This termite has been intercepted at Honolulu with *Sobralia panamensis* from the Canal Zone; at Washington, D.C. with *Epidendrum* sp. from Costa Rica, and with *Cattleya* sp. from Colombia; in New Jersey with *Cattleya* sp. from Colombia and Costa Rica.

### 2. *Nasutitermes* sp.

Has been intercepted in California with *Cypripedium lowii giganteum* from Borneo.

## COLLEMBOLA

### *Orchesella cincta* (Linn.)

Young plants just germinating from seeds are subject to destruction by these small insects.

## INSECTS WHICH POLLINATE ORCHIDS

Quite a number of insects have been recorded as definitely having been observed visiting orchid flowers and being instrumental in performing pollination. The structure of the flowers in most species is such that it requires the visit of an insect to which the pollen masses, or pollinia, become attached in such a position so that when the next flower is visited, the pollen comes into contact with the stigmatic surface, and thus brings about cross-pollination. In Darwin's book on "Fertilization of Orchids," the structure of various kinds of orchid flowers is explained with reference to the manner in which this pollination by insects could be accomplished, and in some cases the actual species of insect is mentioned, but in the majority of cases the actual species of insect which would be involved has not been observed and, hence, not mentioned. Those which have been observed visiting orchid flowers, or have been captured and found to have orchid pollinia attached to some part of the body are mainly butterflies, night-flying moths, bees, and small flies.

The following list includes insects which have been found in literature, most of them being from Darwin's "Fertilisation of Orchids".

#### BUTTERFLIES

1. *Polyommatus alexis* Hübner
2. *Lycaena phlaeas* (Linn.)
3. *Arge galathea* (Linn.)
4. *Hesperia sylvanus* Esper
5. *Hesperia linea* Fabr.
6. *Syricthus alveolus* (Hübner)

These six butterflies were collected, having pollinia of *Orchis pyramidalis* attached.

7. *Nisoniades* sp.

Collected with pollinia of *Platanthera hookeri* on eyes.

8. *Pyrgus elmo* Trimen

Collected with pollinia of *Bonatea darwinii* on sternum.

#### MOTHS

1. A sphingid moth has been discovered in Madagascar with proboscis long enough to reach the nectar in the 11½-inch nectary of *Angraecum sesquipedale*.

2. *Agrotis segetum* Schiff.

3. *Anaitis plagiata* (Linn.)

These two moths were collected having pollinia of *Habenaria bifolia* attached at base of proboscis.

4. *Cucullia umbratica* Linn.

5. *Hadena dentina* (Esper)

6. *Phisia vaureum* Guen.

Collected with pollinia of *Habenaria chlorantha* attached to eyes.

7. *Lithosia complana* (Linn.)

8. *Anthrocera filipendulae* Linn. (Zygaenidae)

9. *Anthrocera trifolii* Esper (Zygaenidae)

10. *Leucania lithargyrae* (Esper)

11. *Caradrina blanda* Treitschke

12. *Caradrina alsines* (Brahm)
13. *Agrotis cataleuca* (Boisduval)
14. *Eubolia mensuraria* Schiff.
15. *Hadena dentina* (Esper)
16. *Heliothis marginata* (Fabr.)
17. *Xylophasia sublustris* (Esper)
18. *Euclidia glyphica* (Linn.)
19. *Toxocampa pastinum* Treitschke

20. *Melanippe rivaria*
21. *Spilodes palealis* Schiff.
22. *Spilodes cinctalis* Treitschke

23. *Acontia luctuosa* Esper

The above moths (nos. 7-23) were collected with pollinia of *Orchis pyramidalis* attached to the proboscis.

24. *Plusia chrysitis* (Linn.)
25. *Plusia gamma* (Linn.)
26. *Anaitis plagiata* (Linn.)
27. *Triphaena pronuba* (Linn.)

Moths nos. 24-27 were caught at night with pollinia of *Gymnadenia conopsea* on proboscis.

#### BEES

1. *Andrena nigro-olivacea* Dours
2. *Andrena senecionis* Perez

Flowers of *Ophrys lutea* visited by these two bees.

3. *Andrena nigroaenea* var. *nigrosericea* Dours

Flowers of *Ophrys fusca* visited by this bee.

4. *Andrena trimmerana* (Kirby)

This bee visited flowers of *Ophrys fusca* and *Ophrys arachnitiformis*.

5. *Andrena* spp.

Five species have been observed to pollinate flowers of *Cypripedium calceolus*.

6. *Apis mellifera* Linn.

The honeybee was observed pollinating flowers of *Epipactis palustris*, *Orchis morio* and found trapped in flowers of *Cypripedium parviflorum*.

7. *Eucera longicornis* (Linn.)

8. *Osmia rufa* (Linn.)

Fertilized flowers of *Orchis morio*.

9. *Halictus pilosus* Smith

10. *Halictus confusus* Smith

11. *Nomada cuneata*

Were found trapped in flowers of *Cypripedium parviflorum*.

12. *Bombus muscorum* (Linn.)

Observed visiting flowers of *Orchis morio* and *Orchis mascula*.

13. *Bombus lucorum* (Linn.)

Observed visiting flowers of *Epipogium gmelini*.

14. *Bombus pratorum* (Linn.)

Collected with pollinia of *Goodyera repens* on proboscis, also with pollinia of *Orchis morio*.

15. *Bombus silvarum* (Linn.)

16. *Bombus lapidarius* (Linn.)

17. *Bombus confusus* Schenck

Collected with pollinia of *Orchis morio* attached.

*Bombus* sp.

Pollinated flowers of *Sobralia macrantha*.

*Bombus* (several undetermined species)

Pollinated flowers of *Spiranthes autumnalis*, *Oncidium* sp. and *Orchis latifolia*.

Twelve kinds of bees have been observed visiting flowers of *Orchis latifolia*. Names were not given.

18. *Ceratina albilabris* (Fabr.)

Pollinated *Serapias cordigera*.

19. *Euglossa piliventris* Guerin

20. *Euglossa caennensis* (Fabr.)

Pollinate flowers of *Catasetum tridentatum* and *Monachanthus viridis*.

**Euglossa** sp.

Found with pollinium of *Stanhopea* on its back.

**Euglossa** sp.

Seen gnawing the labellum of *Catasetum*, *Coryanthes*, *Gongora* and *Stanhopea*.

**Euglossa** sp.

Pollinates *Coryanthes macrantha*.

21. **Xylocopa violacea** (Linn.)

Found with pollinia of *Aceras* (*Orchis*) *longibracteata* attached to its forehead.

## STINGING ANTS

Inhabit special cavities in the pseudobulbs of *Schomburgkia tibicinus*, *Diacrinus bicornutum* and *Diacrinus bilamellatum*.

## WASPS, ETC.

1. **Crabro brevis** Linden

This wasp observed to pollinate *Epipactis palustris*.

2. **Lissopimpla semipunctata** (Kirby)

This ichneumonid pollinates *Cryptostylis leptochila*, *C. ovata*, *C. erecta* and *C. subulata*.

3. **Hemiteles** and **Cryptus**

Have been observed with the pollinia of *Listera ovata* attached.

4. **Scolia** (**Dielis**) **ciliata** (Fabr.)

This wasp pollinates *Ophrys speculum*.

5. **Vespa sylvestris** Scopoli

*Epipactis latifolia* is pollinated by this wasp.

6. **Tetrastichus diaphantus** (Walker)

This small chalcid-fly observed visiting flowers of *Herminium monorchis*.

Hymenopterous and dipterous insects (several spp.) were observed visiting flowers of *Orchis longibracteata* and *Listera cordata*.

## FLIES

1. **Musca domestica** Linn.

The housefly pollinated *Caladenia dimorpha*.

2. **Sarcophaga carnosa**



3. *Coelopa frigida* Fallen

Collected with pollinia of *Epipactis palustris* attached.

*Sarcophaga* sp.

This fly observed feeding on secretion of the flower of *Ophrys mucifera*.

4. *Empis livida* Linn.5. *Empis pennipes* (Linn.)

These two flies were observed in numbers inserting proboscis in nectary of *Orchis maculata*.

## 6. Bombylius-like fly

Was observed visiting flowers of *Disa grandiflora*.

## DIPTERA (Undetermined)

Flies were observed visiting the flowers of *Acianthus sinclairii* and *Cyrtostylis oblonga*.

Several species of flies (some minute) fertilize the flowers of *Pterostylis banksii*, *P. graminea*, *P. puberula* and *P. trullifolia*.

## BEETLES

1. *Malthodes brevicollis* Paykull

Visited flowers of *Herminium monorchis*.

2. *Strangalia atra* Panzer

This longicorn beetle was captured with a tuft of the pollen-masses of *Orchis latifolia* attached to the front of its mouth.

## THRIPS

In flowers of *Listera ovata*, scattering of pollen was largely aided by thrips.

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Distribution of *Icteronysius* with Description of a  
new Subspecies from Haleakala

(Hemiptera, Lygaeidae)

By ROBERT L. USINGER

(Presented at the meeting of May 8, 1944)

IN my monograph on "The genus *Nysius* and its allies in the Hawaiian Islands" (Bishop Museum Bulletin 173, 1942) I referred *Nysius ochriasis* Kirkaldy to the genus *Neseis* and proposed a new subgenus, *Icteronysius*, for the Mauna Loa species, *ochriasis*, and for the Mauna Kea species which I called *maculiceps*. At that time I remarked that, "*Icteronysius* appears to be a special development on *Sophora* on the volcanic slopes of Mauna Kea and Mauna Loa but should be looked for elsewhere on this same host, especially on Haleakala".

At my request, Mr. Paul H. Baldwin, Assistant Superintendent of the Hawaii National Park, has since collected a series of *Icteronysius* on Haleakala. Careful study of these specimens reveals that the group is a compact one, the Maui form exhibiting a trivial reshuffling of characters similar to other subspecific groups in *Neseis*, e.g. *nitidus* (White) and *hiloensis* (Perkins). Since such slight but constant differences were relegated to a subspecific level in other Hawaiian Orsillini, the subgenus *Icteronysius* should be considered as a single species complex. The new combinations are as follows: *Neseis* (*Icteronysius*) *ochriasis ochriasis* (Kirkaldy) and *Neseis* (*Icteronysius*) *ochriasis maculiceps* (Usinger). The Maui subspecies is described below and is named in honor of Mr. Paul H. Baldwin.

***Neseis* (*Icteronysius*) *ochriasis baldwini* Usinger, new subspecies**

Head less than half again as wide as long, 29::22; produced in front of the eyes for a distance equal to length of an eye; eyes about one-third the width of interocular space, 5½::18; upper surface moderately elevated, the clypeus and oblique areas in front of ocelli glabrous, elsewhere rugose and clothed with decumbent hairs. Bucculae well elevated anteriorly, decreasing behind level of antenniferous tubercles and disappearing before base of head. Rostrum reaching apices of hind coxae, the first segment scarcely over one-fourth longer than width of pronotum, 62::47; proportion of segments 10:17:17:18.

Pronotum less than twice as broad as long, 47::26; about half again as broad as head, 47::32; and longer than head on median line, 26::22. Lateral margins nearly straight, slightly rounded anteriorly and abruptly so at humeri, finely pubescent. Disk moderately convex and glabrous behind, depressed at callosities which are surrounded by decumbent hairs.

Hemelytra complete, exceeding tip of abdomen by less than one-third the total length of membrane, 21::70. Membrane shorter than costal margin,

70::76; produced as far beyond level of apices of coria as in front of this. Clavus and corium clear, hyaline, vein R+M branching at apical fourth; costal margins gradually dilated beyond level of apex of scutellum, widest at level of apex of commissure of clavus.

Postero-lateral angle of metapleuron moderately produced, rounded at apex. Under surface clothed with a short, appressed, golden pubescence. Female genital cleft deep, the fourth abdominal segment concealed beneath the third at middle.

Color largely ochraceous with black markings on the head as in *maculiceps* but with a pair of longitudinal black vittae on base of tylus and without black on juga and surrounding tylus. Other black areas include punctures, middle of first antennal segment, bases of second and third segments, apex of rostrum, buccal groove, thoracic sterna and basal half of the abdominal venter at middle, femoral spots, apices of tarsi and claws.

Size: male, length 4.4 mm., width 1.4 mm.; female, length 4.86 mm., width 1.56 mm.

Holotype male, allotype female, and six paratypes, Paliku cabin, Waikekeehia, Haleakala Crater, Maui, elev. 6350 feet, Nov. 24, 1943, collected from mamani, *Edwardsia (Sophora) chrysophylla*.

*Baldwini* is closely allied to *maculiceps*, with a similar black pattern on the vertex, but differs in color pattern elsewhere on the head and body and has a shorter rostrum which reaches or only slightly surpasses the apices of hind coxae.

**The Aculeate Wasps of New Caledonia,  
with Natural History Notes**

By **FRANCIS X. WILLIAMS**

Experiment Station, H.S.P.A.

*(Presented at the meeting of December 11, 1944)*

IN May 1940 the Experiment Station of the Hawaiian Sugar Planters' Association sent the writer to New Caledonia to collect and study the insect pests of that large island. The data thus secured would enable Hawaii to safeguard itself more effectively against the accidental introduction of any such pests. Incidental to this work on economic entomology, opportunity was afforded to study the biota—with special reference to the stinging wasps—of that most interesting region.\*

I spent from July 3 to November 12—roughly from the very mild midwinter to the commencement of summer—in New Caledonia, paying particular attention to the area about Noumea, the capital city near the southern extremity of the island, but visiting farther south to the Isle of Pines and proceeding northward to the Nepoui valley on the west coast, and to Hienghene well beyond the middle length of the island, on the east. Mrs. Williams who accompanied me took all the photographs in New Caledonia and otherwise helped me in my work.

During our stay in New Caledonia we were assisted in many ways. Referring particularly to travel and to stops in out-of-the-way places, thanks are due to Mr. and Mrs. L. Want for a delightful stay at their ranch at Oua Tom on the west coast, and to Mr. T. Mulhern at whose lumber camp well up the Nepoui valley we spent a week. A trip to the Isle of Pines and way points was made possible through the courtesy of Mr. N. Hagen. Finally, Albert Rog  r, manager of Garage Rog  r, proved indispensable in his knowledge of people and places, and in arranging trips and in his reassuring operation of the automobile. Above all, the various government officials were always gracious in granting travel and stopover permits.

Mr. Robert Viro  t, trained botanist, determined many plants for me and in our several field trips in his congenial company gave me a better understanding of the botany. Mr. Viro  t's "Esquisse Phytog  ographique Neo-Caledonienne" (*Etudes Melanesiennes*, 1(2): 25-29, 1939) is a useful contribution to the botany of the island.

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\*The types of the species described in this paper are in the collection of the Experiment Station, H.S.P.A., Honolulu.

Mr. E. C. Zimmerman, entomologist of the Bernice P. Bishop Museum, Honolulu, furnished the Experiment Station, H.S.P.A. a catalogue of the insects known to occur in New Caledonia, which has helped a great deal.

The island of New Caledonia was discovered by Captain James Cook in 1774, and is a dependency of France. It lies just within the Tropic of Capricorn and is about 750 miles northeastward of



Fig. 1. Vegetation on the summit of Mount Mou, elevation about 4,000 feet. In the foggy background may be seen the dim forms of native *Araucaria* pines.

Brisbane, Australia, and somewhat less that distance southwestward of Fiji. It is 220 miles long with an average breadth of 25-30 miles and has a total area, including off-lying islands, of 7,200 square miles (Pacific Islands Pilot, 1 [Western Groups] 3rd. ed.: 43, 1928). It is thus more than half as large again as Viti Levu or Hawaii, largest islands in the Fijian and Hawaiian groups, respectively. Less than 30 miles beyond its southern extremity is the Isle of Pines (58 sq. m.), while 50 miles or more off the east coast are the small Loyalty Islands, both under the jurisdiction

of New Caledonia. The more fertile New Hebrides lie some 200 miles north and east.

New Caledonia is nearly enclosed by a barrier reef. It is an ancient island without volcanic activity. It is ruggedly mountainous, the highest points being Mount Panie in the north and Mount Humboldt in the south. Both are approximately 5,400 feet high. Some 20 miles northwest of Noumea and easily accessible from

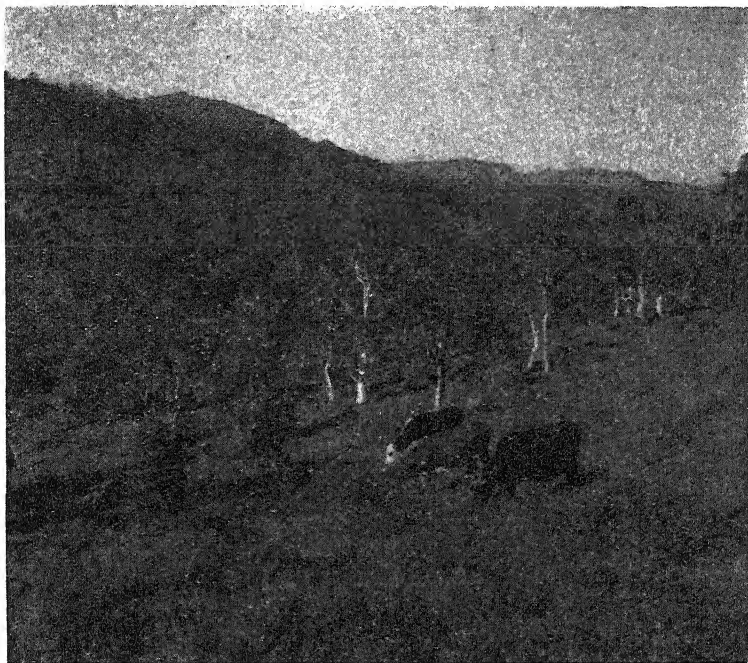


Fig. 2. Hills behind Noumea, showing a forest of "niaouli" (*Melaleuca leucadendron* var. *viridiflora*). Towards the upper right is the nipped summit of Mount d'Or.

that city is the square-topped Mount Mou, elevation about 4,000 feet and a familiar landmark. It is a good collecting place, from base to summit, on which there is a small mossy forest (text figure 1). The east coast is more rugged and generally wetter than the west, which appears to have more mangrove swamps and more extensive open forests of the shaggy-barked "niaouli" (*Melaleuca leucadendron* Linn., var. *viridiflora* Gaertn., Myrtaceae), (text figure 2). Forest consisting of many kinds of trees, ferns, other undergrowth and some palms occur in pockets in valleys and



on the slopes of higher mountains. They have suffered much from the inroads of man.

From a standpoint of zoögeography New Caledonia is generally placed in the Australian region. As a subdivision of this region it has been variously classified. Forel, for example, regards New Caledonia as a sub-fauna of the Australian fauna (The Social World of Ants, 1: 149, 156, 1930). A classification perhaps more

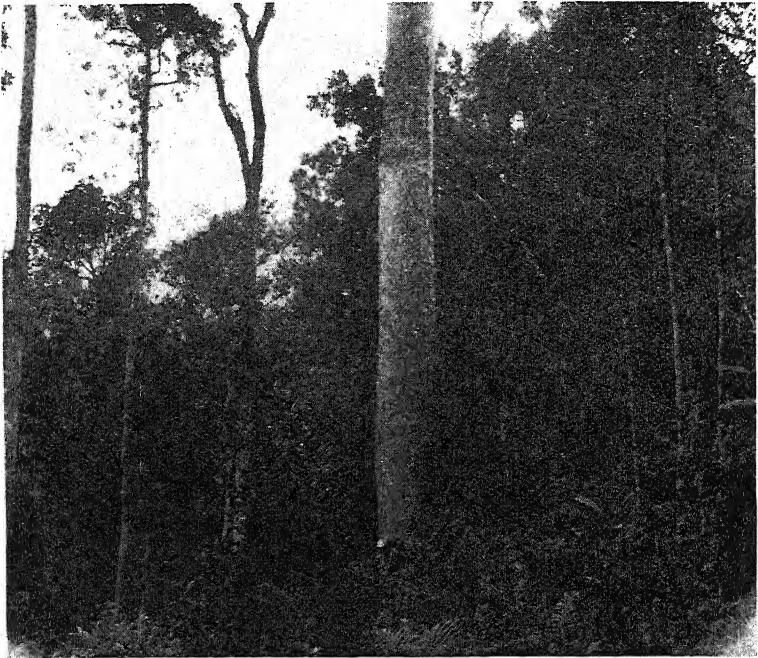


Fig. 3. Kauri pine (*Agathis* sp.) in the Marmite forest, New Caledonia. The writer's white helmet on the left side of the trunk at the base.

generally accepted, is to consider Fiji together with New Caledonia and probably the New Hebrides, as belonging to the Melanesian subregion, as has been done by Mann (The Ants of the Fiji Islands, Bull. Mus. Comp. Zool. 64: 405, 1921). Tillyard, in subdividing the Australian region, places New Caledonia in the Papuan province, which he considers as embracing all the islands lying east of Wallace's Line. Chief among these islands are Celebes (at least its highlands), Timor, New Guinea, the Solomons, the New Hebrides, New Caledonia and Fiji. (The Biology of Dragonflies: 292, Cambridge, 1917).

At the time of our visit, Noumea and its environs hardly presented a tropical picture. None of the trees along the streets and in the parks appeared to be in blossom, while the grassy hills rising immediately behind the city and culminating in Mt. Montravel,



Fig. 4. A grove of *Pandanus* in the Nepoui Valley.

about 548 feet high, were generally quite brown. Later on in these hills small colonies of dwarf ground orchids thrust their pretty white or bluish flowers upwards among the dry grass stems, and certain other plants came into flower. Tiny ponds, nestled in the small valleys, support a fair representation of water-loving insects and other invertebrates. Here one could find several species of

dytiscid and hydrophilid beetles and one or two gyrinid beetles, saldid, notonectid, and hydrometrid and other surface bugs, some of the commoner dragonflies, the sluggish larva of a stratiomyid fly, mosquitoes, etc. A small shrimp was not uncommon.

Butterflies are probably the most obvious insects about the city and in the little forest remnants that still persist in the small valleys

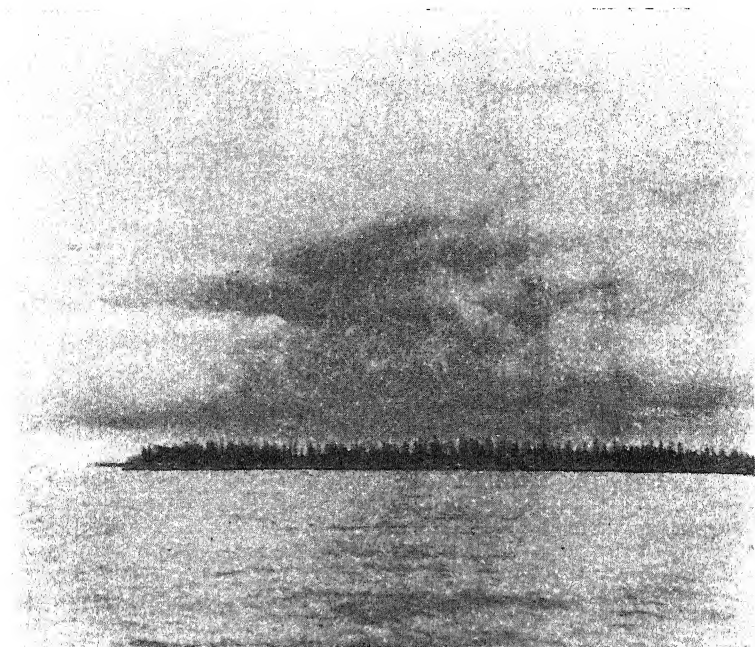


Fig. 5. Coral islet off the southern shore of New Caledonia. To show growth of *Araucaria cookii*.

nearby. In this area at least 15 species may be taken. Conspicuous among these is the glossy blue *Papilio montrouzieri* Boisd., with the more slowly flying, blackish, yellowish white and brown *Papilio amyntor* Boisd. also well known. The skipper butterfly, *Badamia exclamationis* (Fabr.)—or a variety of it—though not often seen in the adult stage, feeds as a caterpillar banded zebra-like, on the foliage of the tropical almond, *Terminalia catappa* Linn., to young trees of which it may cause some damage. One or more kinds of dark velvety *Euploea* butterflies flit about shady places. The widespread *Hypolimnys bolina* (Linn.) with the sexes so differently colored, is common. Long ago, J. J. Walker (Ent. Mo. Mag. 12 : 192, 1901) noted the resemblance between the female

of this butterfly and *Papilio amyntor* in New Caledonia. Other common butterflies are *Precis villida* (Fabr.), *Danaus plexippus* (Linn.), *Cosmolyce boetica* (Linn.) and two migratory pierids, *Anaphaeis java* (Fabr.), race *peristhene* (Boisd.) and *Appias paulina* (Boisd.), var.

I took seven species of sphingid moths. Probably at least double that number occur in New Caledonia. *Hippotion celerio* (Linn.) the taro sphinx, sometimes nearly defoliates taro and *Caladium* plants. A large pale gray species evidently closely related to, if not the same as the Australian *Casuarina* sphinx (*Psilogramma menephron casuarinae* Walk.), was sometimes attracted to light. *Herse convolvuli* (Linn.) was rarely seen. A single forewing of a sphingid found in a forest near Noumea was identified as belonging to a species of *Macroglossa*. Two specimens of *Cephanodes janus* Miskin, one of the so-called bee or clear-wing hawk moths, were captured at or about the flowers of *Lantana camara* Linn.

Large noctuid moths are well represented in New Caledonia. The larva of one species feeds on the foliage of the "niaouli" tree and hides during the day under the shaggy bark, the quantities of frass at the base of the tree or wedged between the loose bark often revealing its presence. The moths themselves were often found impaled on the thorns of *Acacia farnesiana* Willd.—evidently the work of shrikes.

The use of a beating net on the scrubby growth will often yield a good catch of insects: small weevils, a tiny buprestid beetle that seems to breed in the wood of the dwarf *Casuarina*, small geometrid moth larvae on the same shrub, thrips and other insects. Conspicuous on the thorny *Acacia farnesiana* shrubs are the egg cases of a mantid, probably *Tenodera australasiae* Leach, that often show emergence holes of *Podagrion* sp., one of the chalcid wasps. Large acridiid grasshoppers, most conspicuous of which was *Austtracris guttulosa illepida* (Walk.) rise up before you to fly swiftly downwind. The shrill, almost ear-piercing stridulation of a cicadid suddenly ceases at your approach. And as we wend our way along the goat trails on these brown hills at sunset, the mellow, almost continuous note of *Oecanthus rufescens* Serv., a pale brown cricket, arises from among the weeds and tall grass.

The native forest with its well-wooded stream offers far more incentive to the entomologist. Here the endemism is higher, and the glimpse of some desirable insect or the capture of single specimens of apparently new species spurs one to more and more visits to his favorite stream and wood.

A number of species and even some families of insects were not in season during my stay in New Caledonia. For example, except for one or two elytra wrapped up with other insect remains in an orb web of a common epeirid spider, I saw no evidence of any of

the fine endemic cicindellid beetles. Although a number of larvae of elaterids were found, chiefly under the bark of a fallen tree in the forest, only two or three adult beetles were taken. An elaterid larva of formidable size occurred rarely under bark where it may have preyed upon the grub of large cerambycid beetles. Collecting under the bark of dead trees was often good, yielding many species of beetles and such other good things as large collembolous insects and a species of *Zorotypus* (Zoraptera).

Aquatic beetles are rather well represented in New Caledonia, particularly where streams are sluggish or have broken up into isolated pools, thus concentrating the fauna. A new experience for the writer were the habits of a species of *Macrogyrus*, a whirligig beetle (Gyrinidae) with much the appearance of *Dineutes*, also represented in New Caledonia. In the more pool-like portions of a clear stream deep in the forest, and at a depth of some seven inches beneath the surface of the water, groups of these beetles, head end inclined slightly downwards, maintained their position with an occasional stroke of the legs. Now and then a *Macrogyrus* would come up for air, but would soon dive to rejoin its group.

The dragonflies (Odonata) of New Caledonia are of considerable interest, both the Zygoptera and the Anisoptera being in good proportion. Champion in his "Odonata collected in New Caledonia by the late Paul Montague" (Ann. Mag. Nat. Hist. [9] 8: 33-67, 11 text figures and 2 plates, 1921) lists 26 species as definitely known to inhabit New Caledonia and the Loyalty group. To this list must be added *Anax gibbosulus* Rambur and *Macrodiplax cora* (Brauer), the former recorded from New Caledonia prior to 1928 (see Cheesman, Trans. Ent. Soc. London, 75: 153, 1927), the second taken by the writer in 1940. Both of these dragonflies are Old World tropical species. Among the Libellulidae, pretty little *Diplacodes*, represented by two species of which I took but one, were common about little pools. The male has the body bright red. The larger *Orthetrum caledonicum* Brauer, also common but difficult to catch, has a pale glaucous or brown abdomen. Less often seen were a species of *Tramea*, *Macrodiplax cora* and the worldwide *Pantala flavescens*. In the subfamily Corduliinae, I took only *Hemicordulia fidelis* MacLachlan. Several fine species of the genus *Synthemis* occur. The Zygoptera or damselflies are represented by ten species, of which seven are endemic. The non-endemic ones are *Ischnura delicata* (Hagen) (= *Ischnura aurora* [Brauer]) and *Ischnura heterosticta* Burm. and *Agriocnemis exsudans* Selys. Along forest streams the relatively large *Argiolestes ochraceus* (Montr.) was occasionally taken; the males when in mature coloration, are heavily marked with bright ochraceous that gives them a striking appearance. A moderately large, very slender *Isosticta* was also found in the same localities, its exuviae were not uncommon on boulders in the Thi River, the nymphs themselves, provided with

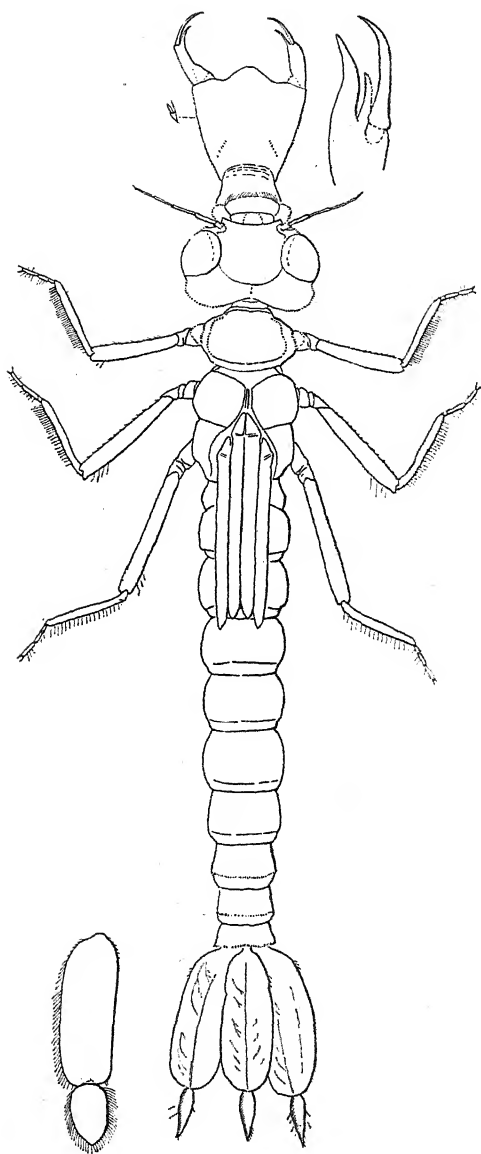


Fig. 6. Nymph of a damselfly (*Isosticta robustior* [?]). Drawn from an over-turgid specimen that was preserved in alcohol. There are no raptorial setae on the labium, and the anal gills are saccate. Thi River near St. Louis, New Caledonia.

saccate gills (text figure 6) were taken under stones in the same stream. Large water-running spiders, and also a species, that when disturbed, crawled even to the bottom of pools carrying its flat eggcase beneath its cephalothorax, are probable enemies of these and other Odonata.

An important paper that includes some of the New Caledonian Zygoptera is "New Genera of Megapodagrioninae, with Notes on the Subfamily" by C. H. Kennedy (Bull. Mus. Comp. Zool. 67: 289-312, one plate, 1925).

#### ACULEATE WASPS

Thirty-seven species of aculeate wasps now appear to be definitely recorded from New Caledonia. Six or seven of these were not taken by the writer. Fourteen new records are here included. The Pompilidae with about 12 species are best represented. A number of additional species of aculeate wasps are to be expected from this island.

#### MUTILLIDAE

***Ephutomorpha caledonica*** (André) (pl. 18, figs. A and C)

André Ann. Mus. Civ. Stor. Nat. Genova, (2) 17: 96, 1896, ♀ (*Mutilla* [*Sphaerophthalma*] *caledonica*). (I have not seen this description).

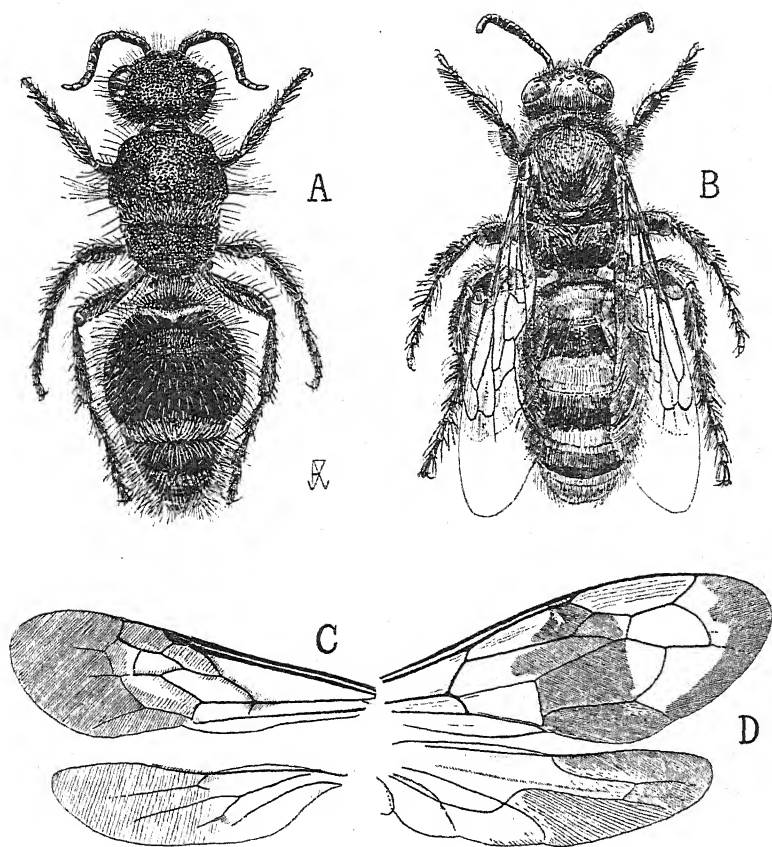
André, Gen. Insect., 11: 49, 1903, ♀. (*Ephutomorpha caledonica* ♀).

Mickel, The Mutillid Wasps of the Islands of the Pacific Ocean (Hymenoptera; Mutillidae). Trans. Roy. Ent. Soc. London, 83 (2): 177-312 (296, etc.), 1935.

New Caledonia: Noumea, 1 ♀, August 10, 1940; Isle of Pines, 5 ♂♂ and 6 ♀♀ (F. X. Williams). The specimens from the Isle of Pines were taken near the seashore where such aculeate hymenoptera as *Pompilus*, *Tachysphex fanuiensis* and small native bees were also to be found.

A rather small mutillid, with white abdominal hair bands, the male shining purplish blue and the wings fuscous for about their apical half, the female blackish with head and thorax subopaque.

Mutillidae are parasitic chiefly on bees and wasps. The female is always wingless. No species are known to occur on oceanic islands. New Caledonia is the most eastern Pacific island on which these insects are found. The genus *Ephutomorpha* is predominantly Australian. (See Mickel, 1935; and Zimmerman, E. C., [Distribution and Origin of Some Eastern Oceanic Insects], American Naturalist, 76: 280-307, 1942).



EXPLANATION OF PLATE XVIII

A.—*Ephutomorpha caledonica*, female. Length 7 mm.

B.—*Campsomeris novocaledonica*, female. Length 22 mm.

C.—*Ephutomorpha caledonica*, male wings.

D.—*Cyphononyx vitiensis*, male wings. From Suva, Fiji.



## THYNNIDAE

A. von Schulthess (Sarasin, Nova Caledonia, Zool. 2 [1]: 46, 1915) records *Eirone* sp. ♂, from Canala, New Caledonia.

Turner (Ann. Mag. Nat. Hist., [9] 3: 236, 1919) described *Eirone obtusidens* from a ♂ specimen taken at Noumea.

Montet (Rev. Suisse zool. Genève, 29: 184, fig., 1922) described *Spilothynnus thalluse* female from New Caledonia, but the correctness of this locality appears to be in doubt. I have not seen Montet's description.

Cockerell (Psyche, 36: 239-242, 1929) described *Eirone superstes* from a ♂ taken at Bourail, New Caledonia, and adds "Allied to *E. obtusidens* Turner. . . ."

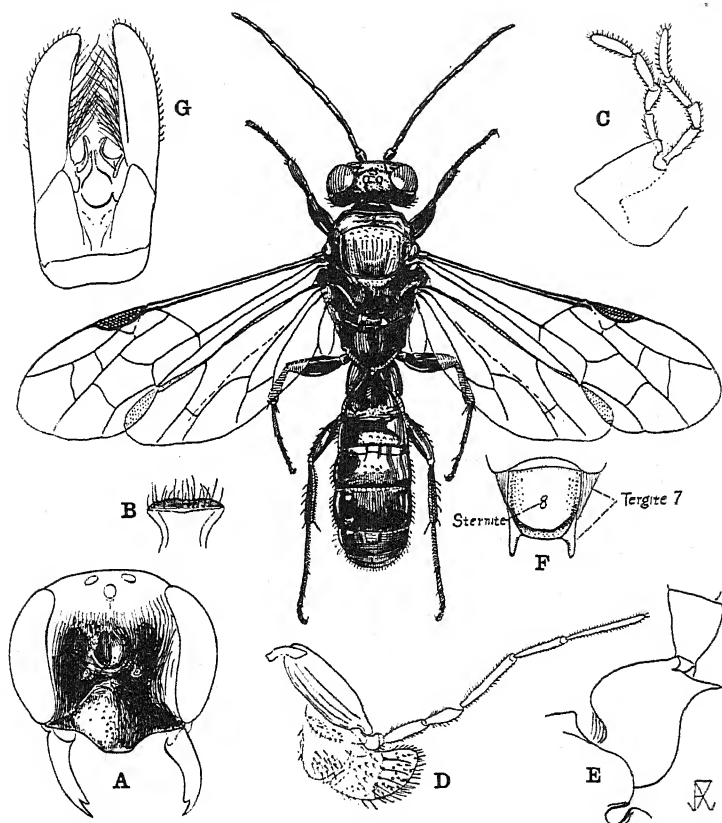
***Eirone neocaledonica*, n.sp. (pl. 19)**

*Male*, type: Length 10 mm. Shining black, puncturation generally sparse; mandibles rufous apically. Head transverse, slightly wider than pronotum; clypeus produced subtruncate mesad, not carinate, the disc convex and somewhat sunk into the face which has an oval depression mesad above the antennae; mandibles bidentate, of uniform width; antennae slender, rather short, joint 3 shorter than 4, the last 6-7 joints rather arcuate; eyes gently emarginate within, subparallel; ocelli in a low triangle. Pronotum short, the anterior margin raised, the posterior arcuate. Mesonotum with two pairs of parapsidal grooves, the inner enclosing a raised area. Scutellum somewhat elevated anteriorly, posteriorly very little rounded mesad. Postscutellum with a transverse sinuate depression anteriorly, the posterior edge gently emarginate mesad. Propodeum with dorso-lateral tubercles, a triangular depression extending on disc as a median groove with sparse punctures on either side; disc gently rounded into sloping posterior face. Wings lightly infusate, with a purple iridescence. Midcoxae with an apical thorn ventrad. Abdomen somewhat arcuate and depressed, the inter-segmental constrictions moderate; tergite 1 sulcate mesad to beyond middle length, 3 with a basal transverse lamina emarginate mesad; 7 emarginate, the lateral processes thus formed rather blunt; sternite 8 rounded out, simple; claspers with an inner fringe of rather long hairs. Vestiture: sparse pale hair on head, thorax and legs; tergites with a subapical row of dark bristles, bristles more extensive on 7; sternites with bristles more generally distributed.

New Caledonia, Thi River valley, near St. Louis, November 1, 1940. F. X. Williams, one specimen flying low over ground in forest.

Abundantly distinct from the two other species described from New Caledonia. These are marked with yellow, their clypeus triangularly produced, and there are other different structural characters.

The Thynnidae are distributed chiefly in the southern hemisphere, their headquarters being Australia, where hundreds of species have been described. The family has been monographed by Dr. R. E. Turner (Proc. Linn. Soc. N. S. Wales: 32, 1907; 33, 1908; and Family Thynnidae, Gen. Insect.: 105, 1910). Except for the three species of *Eirone* reported from New Caledonia this genus appears to be strictly Australian.



EXPLANATION OF PLATE XIX  
*Eirone neocaledonica* male. Length 10 mm.

- A—Head, from in front.
- B—Labrum.
- C—Labial palpi.
- D—Maxillary palpi.
- E—Middle coxa, to show apical ventral thorn.
- F—Cauda, from ventral side.
- G—Terminalia.

The females of the Thynnidae are wingless. Save in the monobasic genus *Diamma* they are smaller than the males and are carried about by them in flight. For this reason they are absent from oceanic islands and rare on, or absent from, ancient continental islands. The fact that they parasitize the grubs of scarabaeid beetles—at least to a great extent—would also limit their insular distribution.

The most eastern outpost for the Thynnidae in the Pacific seems to be Caledonia.\*

For the biology of certain Australian Thynnidae, see Burrell, Jl. New York Ent. Soc., 43: 19-28, 1 pl., 1935.

### SCOLIIDAE

**Campsomeris novocaledonica** Turner (pl. 18, fig. B)

Turner, Ann. Mag. Nat. Hist. (9) 3: 237, 1919. ♂ ♀.

Betrem, Monogr. Indo-Austral. Scoliiden (Hym. Acul.) Treubia 9, 388 pp., Suppl. (90-91) 1928, New Caledonia and New Hebrides. Var. *insularum* Betrem, ibid: 91, ♂, described from the Loyalty Islands.

New Caledonia: Thi River valley, 4 ♂ ♂ and 1 ♀, early November 1940; Nepoui, 3 ♂ ♂, early August 1940; Kuebeni islet, near Yate, S. New Caledonia, October 25, 1940 (F. X. Williams). The males were seen flying about an old fallen tree trunk at Thi River. It is probably mainly a forest insect. It is orange and black and up to about 25 mm. long.

Scoliid wasps are parasitic on the grubs of scarabaeid beetles of which a fair number are native to New Caledonia. Insofar as island habitats are concerned both host and wasp are generally restricted to the continental type. The New Caledonian-New Hebrides species is closely related to *C. tasmaniensis* (Sauss.), the only scoliid known from Tasmania, while *C. ovalauensis* (Sauss.) from Fiji, as well as *C. palauensis* (Turner) from Palau, east of the southern Philippines, are more closely related to *C. ferox* (Sauss.) from New Guinea. (See Betrem: 369, 1928.)

Fiji is the most eastern natural outpost for Scoliidae in the Pacific.

### VESPIDAE

Dr. J. S. Bequaert has examined the New Caledonian material and kindly determined the six known species, as follows:

*Eumenes germaini* Lucas

\*The distribution of *Rhagigaster novarae* Saussure (Reise de Nov. Zool. 2: 112, 1867. ♂. "Nova-Zeelandia") seems to be in doubt. Turner (Proc. Linn. Soc. N.S.W., 32: 228, 1907; Genera Insectorum, 105me Fasc. Hymenop., Fam. Thynnidae: 8, 1910) credits it to New Zealand, but Tillyard (The Insects of Australia and New Zealand: 261, 262 and 293, 1926) distinctly indicates that no Thynnidae are known to occur in New Zealand.

*Pachymenes quodi* (Vachal) (= *Odynerus sarasini* Schulthess)

"*Odynerus*" *caledonicus* Saussure

*Rygchium haemorrhoidale* var. *alecto* Lepeletier

*Ropalidia duchaussouyi* (Gribodo)

*Polistes olivaceus* (Degeer) (= *hebraeus* Fabr.)

A few notes are herewith presented on these insects :

***Eumenes germaini* (text fig. 7)**

Lucas, Ann. Ent. Soc. France, (5) 6: 300-302, pl. 4, figs. 1-6, 1876; describes nest and pupa, *ibid*: 296-299, figs. 7 and 8.

This inch-long black and orange wasp was one of the first-

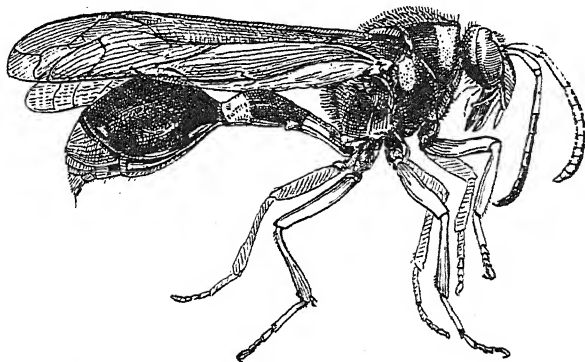


Fig. 7. *Eumenes germaini*, female. Length 25 mm. New Caledonia.

observed insects when we disembarked at Noumea July 3, 1940, and it remained moderately abundant throughout our stay, to November 12. It is widely distributed and endemic in New Caledonia, including the Isle of Pines and the Loyalty Islands. Although a very useful insect, preying as it does upon noxious caterpillars, including both 16-legged and the looping type, the fact that it so frequently plasters its relatively large mud cells on walls and buildings has drawn some complaints. Its cells are also found on banks of clay or rock and attached to the stems of shrubs and trunks of trees. Several cells are built one against the other and each has a jug-shaped mouth later broken down and the group more or less covered with mud. The egg is suspended by a filament from the ceiling of the cell. Few cells containing living larvae or pupae of *Eumenes* were noted. One pupa was found heavily parasitized by a tiny *Melittobia* wasp (*Eulophidae*), while certain cells were occupied by the larva—in the resting stage—of another large eumenid wasp, probably *Rygchium haemorrhoidale* var. *alecto*, soon to appear in the field. Finally, a bombyliid fly (*Argyramoeba distigma* [Wiedemann] 1828 ?) (text figure 8) was found to be parasitic

in the cells of *Eumenes germani*. On one occasion the hairy and spiny pupal shell of the bombyliid was observed partly extruded from the mud nest of the wasp, while on another occasion the pupa had produced its fly within the closed mud cell where, of course, it had perished.

***Pachymenes quodi* (Vachal) (pl. 20, fig. C)**

*Odynerus quodi* Vachal, Rev. d'Ent., 26: 115, 1907. ♀ (= *Odynerus sarasini* Schulthess).

A shining black wasp, 9-10 mm. long, marked with pale yellowish. It is well distributed in New Caledonia, and later during my stay

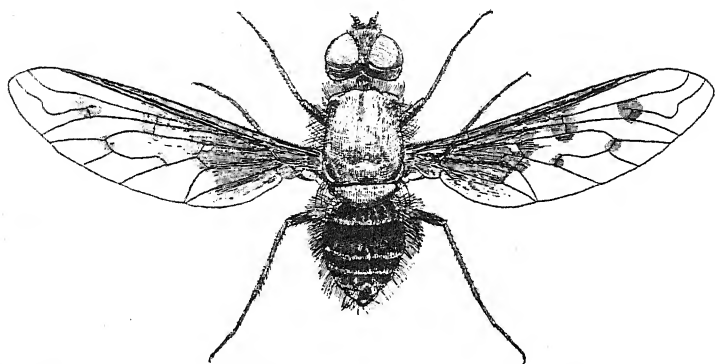
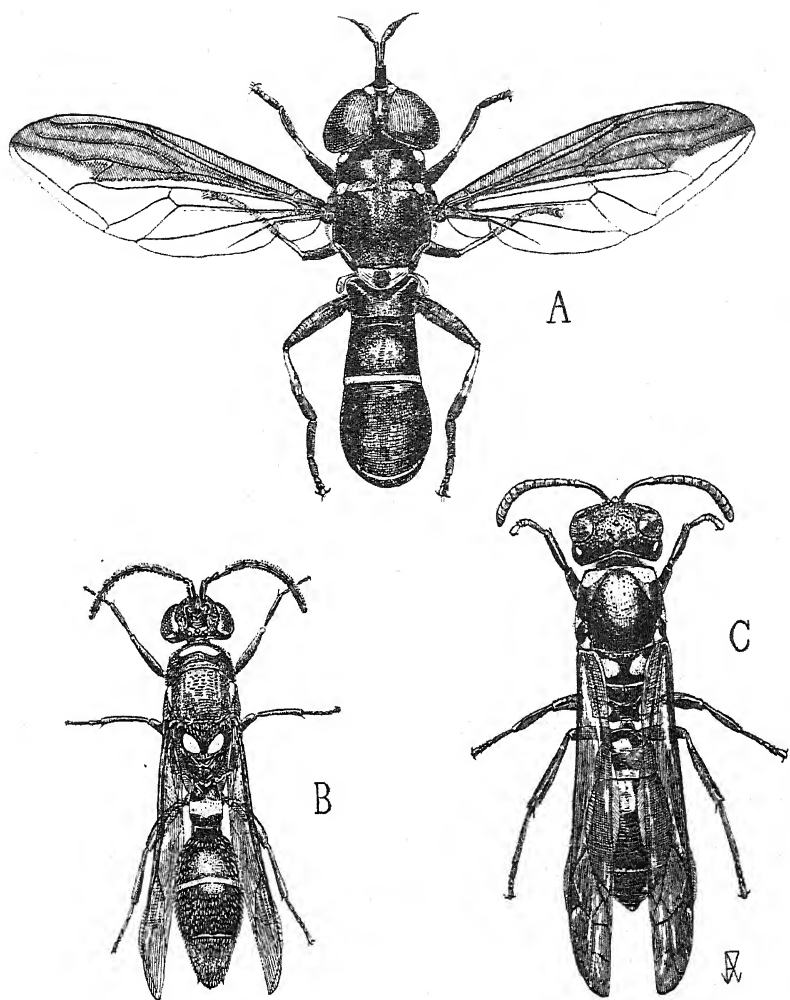


Fig. 8. *Argyrotaenia distigma* (?), parasitic in the cells of *Eumenes germani*.

was not uncommon in gardens in Noumea. Sometimes flying in the same situation as this *Pachymenes* were a handsome syrphid fly of the genus *Cerioda* (plate 20, fig. A) and a large folded-winged parasitic wasp, *Leucospis antiqua* Walker (Jl. Ent., 1: 19-20, 1860; see also Brues, Proc. Haw. Ent. Soc., 11: 153-154, 1942) (pl. 3, fig. B). These two insects bear so considerable a superficial resemblance to *Pachymenes quodi* as to suggest mimicry. On this point see Tillyard (Insects of Australia and New Zealand: 273, 368, 1926). Maindron (Bul. Soc. Ent. France, [5] 8: CLXIV-CLXV, 1878) after describing *Leucospis gambeyi* from the Isle of Pines, New Caledonia, makes note of the general resemblance of the female *L. gambeyi* "d'un Euménien", and of the male *Leucospis*, in a vague way appearing like a male mutillid. Maindron's description of *Leucospis gambeyi* fits *Leucospis antiqua* well enough.

Species of *Leucospis* are generally recorded as parasitic in the cells of such bees as *Megachile*, *Osmia* and *Chalicodoma*. *Megachile* bees are abundant in New Caledonia.

I learned nothing of the biology of *Pachymenes quodi*.



EXPLANATION OF PLATE XX

A—Syrphid fly (*Cerioides*). Length 11.5 mm.

B—*Leucospis antiqua*, male. Length 10 mm.

C—*Pachymenes quodi*, female. Length 11 mm.

All figures to same scale.

**"Odynerus" caledonicus** Saussure

Saussure, Etud. Fam. Vespidae 1: 205, 1852. ♂.

A black and orange-red wasp with flavous wings and about 10-15 mm. long. The first abdominal segment is noticeably narrower at its apex than the base of the second, which in turn is narrower there than at the apex.

Chiefly about Noumea, in October and November; but observed also on the east coast.

**Rygchium haemorrhoidale** (Fabr.) var. **alecto** Lepeletier

Lepeletier, Hist. Nat. Insect., Hymen.: 647, n. 32, 1841, ♀.

A larger and stouter insect than the preceding, and black, brownish and yellow. My first record of this wasp was September 28, when a female was observed at a puddle of water in Noumea. A few specimens taken chiefly at Noumea.

**Ropalidia duchossoyi** (Gribodo)

*Icaria duchossoyi* Gribodo. Misc. Ent., 4: 13, 1896.

This small social wasp was found sparingly at La Foa, September 21, Nepoui, early August, and Hienghene, early October. A large tier of deserted cells of this species was found attached to the trunk of a tree at La Foa, and a small occupied group of cells was suspended under the eaves of a building at Hienghene. Hardly in season.

**Polistes olivaceus** (Degeer)

Degeer, Mem. serv. Hist. Insect., 3: 582, no. 5; pl. 29, fig. 9, 1773 (*Polistes hebraeus* Fabr.).

Chiefly about Noumea, but uncommon.

For the synonymy concerning this wasp see Bequaert and Yasumatsu (Vespoidea of Micronesia, Tenthredo, 2: 314-328 [314-315], 4 pls., 1939).

## POMPIDILIDAE

J. Vachal (Rev. d'Ent., 26: 116-117, 1907) describes *Priocnemis caledonicus* "(an *Pr. tuberculatus* Sm. Cat. p. 166 var. ?)" ♂ ♀, *Priocnemis quodi* ♀ n.sp.?, *Priocnemis* ? *corynodes* ♂, n.sp. and *Pompilus inquirendus* ♂ ♀ "(an *P. opulentus*, Sm. ?)".

A. von Schulthess (Sarasin, Nova Caledonia, Zool., 2 [1]: 48, 1915) records *Priocnemis tuberculatus* Sm. from New Caledonia.

R. E. Turner (Trans. Ent. Soc. London: 340, 1919) records *Psammochares elatus*, Sm. (= *Pompilus inquirendus* Vachal) from New Caledonia; and Ann. Mag. Nat. Hist., (9) 3: 239, 1919, records *Priocnemis caledonicus* Vachal from Noumea and Plaine des Lacs, New Caledonia.

Nathan Banks (Bishop Mus. Occ. Papers, 26: 232-245, 1941) describes *Cyphononyx parvulus* ♂, and *Aglochares* new genus for

*vachali* n.sp. *Cyphononyx vitiensis* Turner is also recorded as occurring in New Caledonia (teste Banks).

In addition to the above list the present writer describes *Priocnemis araucariae* n.sp., *Pr. montrouzieri* n.sp. and *Pr. umbrosicola* n.sp., and records *Homonotus ariadne* (Cam.) ? and a *Pompilus* related to *P. lascivus* Cameron and *P. philippinensis* (Banks), as also occurring in New Caledonia. The above picture is not entirely clear to me but there seem to be 12 species of Pompilidae now known from this island, as follows:

#### CRYPTOCHEILINAE

*Cryptocheilus caledonicus* (Vachal)

*Monodontonyx parvulus* (Banks)

*Cyphononyx vitiensis* Turner

#### MACROMERINAE

*Priocnemis quodi* Vachal

*Priocnemis araucariae* n.sp.

*Priocnemis montrouzieri* n.sp.

*Priocnemis umbrosicola* n.sp.

*Priocnemis corynodes* Vachal

#### POMPILINAE

*Homonotus ariadne* (Cameron) ?

*Aglochares vachali* Banks

*Pompilus elatus* Smith

*Pompilus* sp. near *lascivus* Cameron and *philippinensis* (Banks)

If we study the distribution of the Pompilidae in the tropical Pacific we find that in general, the farther the island is situated from a large land mass the smaller is its pompilid fauna, as follows:

Solomon Islands .....	14	species	(Banks, 1941)
New Caledonia .....	12	"	(Williams, 1945)
Fiji .....	4	"	(Turner, 1917, 1919; Haupt, 1937; an undetermined species in Bishop Museum)
Samoa .....	1	"	(Perkins and Cheesman, 1928)
Society .....	0	"	
Marquesas .....	0	"	
Guam (Marianas) ....	0	"	
Saipan " .....	1	"	(I have seen a single specimen of <i>Pompilus</i> ? ♂, from there [D. G. Hall, coll.] )
Galapagos .....	1	"	(Rohwer, 1924)

In the Hawaiian Islands, the pompilid, *Anoplius luctuosus* (Cresson) is a recent immigrant from the mainland of the United States. It was first recorded in Hawaii by O. H. Swezey in 1912, who took one of these wasps in Honolulu in October 1910.



The presence or absence of these wasps, as above indicated, may also depend upon other factors besides degree of isolation; for example, the type and size of the island, meteorological conditions, abundance and variety of their prey, potential enemies, and the amount and quality of insect collecting that has been done in these places.

**Cryptocheilus caledonicus** (Vachal)

*Priocnemis caledonicus* Vachal, Rev. d'Ent., 26: 116, 1907. ♂ ♀.

I am not familiar with this species. Dr. Turner (1919: 238) says of this species, of which he studied female specimens from New Caledonia: "Closely allied to the Australian species of the group of *P. australis*, Guer."

Save for the presence of a red spot on the mesonotum and the scutellum of *caledonicus*, Vachal's short description would do fairly well for *Monodontonyx parvulus* (Banks), following.

**Monodontonyx\* parvulus** (Banks) (pl. 21, E)

*Cyphononyx parvulus* Banks, Bishop Mus. Occ. Papers, 16: 233, 1941. ♂, Houailou (W. H. Ford).

New Caledonia: 2 ♀ ♀, 1940; Noumea, 4 ♀ ♀, July and October, 1940; Prony Bay, 4 ♂ ♂, October 22, 1940; St. Louis, 2 ♀ ♀, August and October, 1940; Thi River valley—in the hills behind St. Louis—2 ♀ ♀ and 5 ♂ ♂, October and November, 1940; Oua Tom, 1 ♂, September 17, 1940; Hienghene, 1 ♀, October 5, 1940, and Isle of Pines, 1 ♂, October 24, 1940 (F. X. Williams).

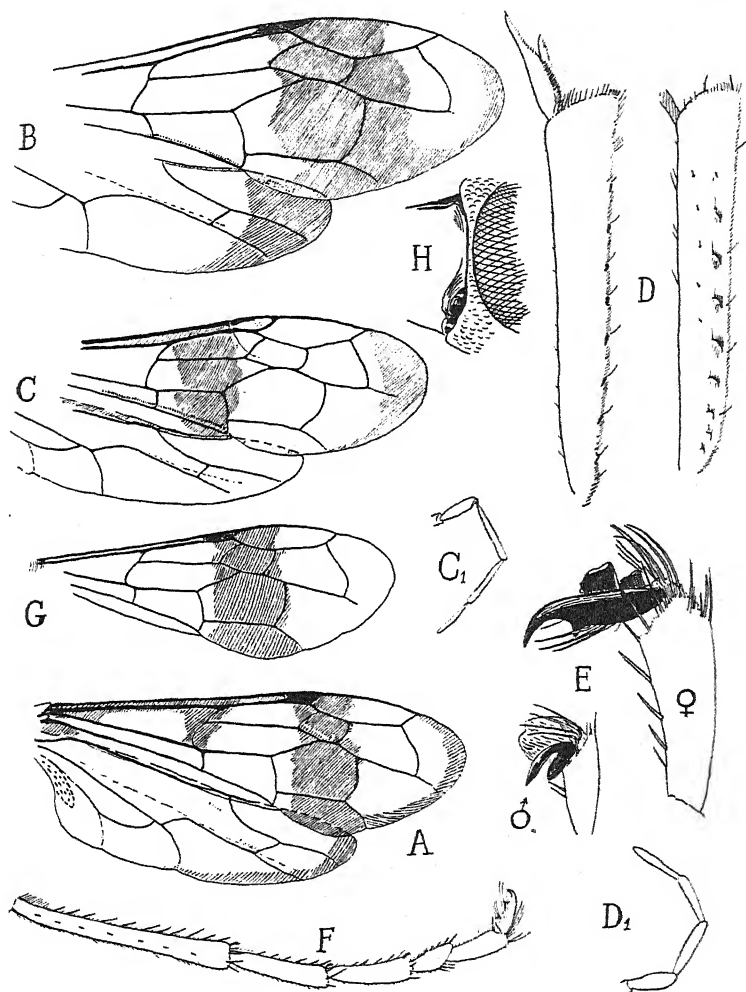
A rather large species, the females measuring up to about 20 mm.; the head, except vertex (♂) and occiput, antennae, legs except coxae, trochanters and base of femora, orange; thorax matt black, with a suggestion of purplish, wings orange, narrowly margined with fuscous and dark also at extreme base; first segment of abdomen, except sometimes a median orange spot above, black, second tergite orange, ringed apically with black, rest of tergites generally orange. The females have all the tarsal claws toothed; the males have the tarsal claws of the first pair of legs cleft—the inner or anterior claw more strongly so—and the claws of the second and third pair of legs toothed.

At the time of my visit this was the most obvious of the New Caledonian pompilids, and it seems strange that it has only recently been described.

**Cyphononyx vitiensis** Turner (pl. 18, fig. D)

Turner, Trans. Ent. Soc. London: 78-80, 1917. ♂ ♀. Described from Fiji, where it seems not uncommon. See also Turner (1918).

\*I am indebted to Mr. Banks for a later determination of the genus of this wasp, as it was previously determined from male specimens.



## EXPLANATION OF PLATE XXI

- A—*Priocnemis quodi*;  
 B—*Priocnemis umbrosicola*.  
 C—*Priocnemis montrouzieri*; C<sub>1</sub> last four joints of maxillary palpus.  
 D—*Priocnemis quodi*, posterior tibia in two views; D<sub>1</sub>, last four joints of maxillary palpus.  
 E—*Monodontonyx parvulus*; female, tarsal claw of third leg; male, tarsal claw of first leg.  
 F—*Priocnemis araucariae*, female type; tibia and tarsus of third leg.  
 G—*Priocnemis araucariae*, type; forewing.  
 H—*Priocnemis umbrosicola*, female type; malar space.

Banks (1941) records it from Wainoni, Solomons as well as from Fiji, and states that it has been recorded from New Caledonia.

A large beautiful species measuring up to 21 mm. long; the head and thorax in part, orange-red, wings orange with a heavy purplish black blotch beyond the middle, and a dusky outer margin; abdomen shining black with apical third or more orange. The tarsal claws of all the legs are cleft in both sexes.

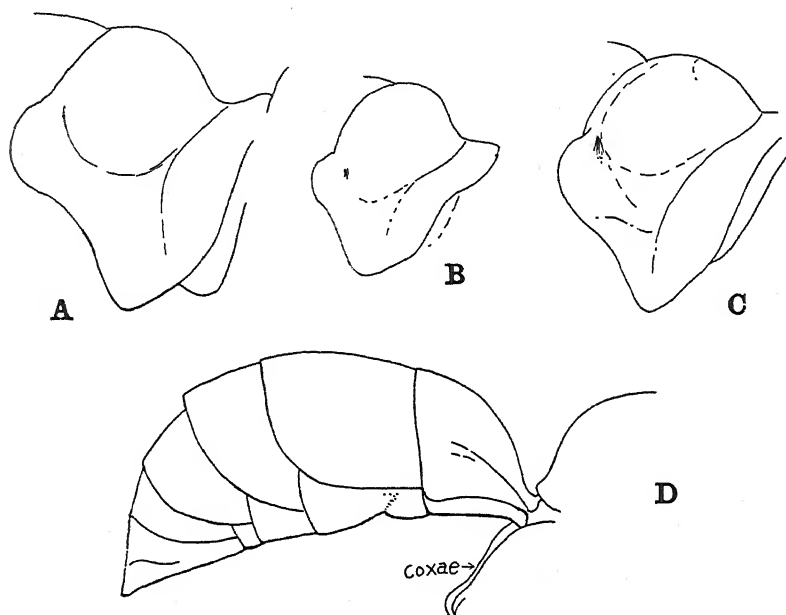
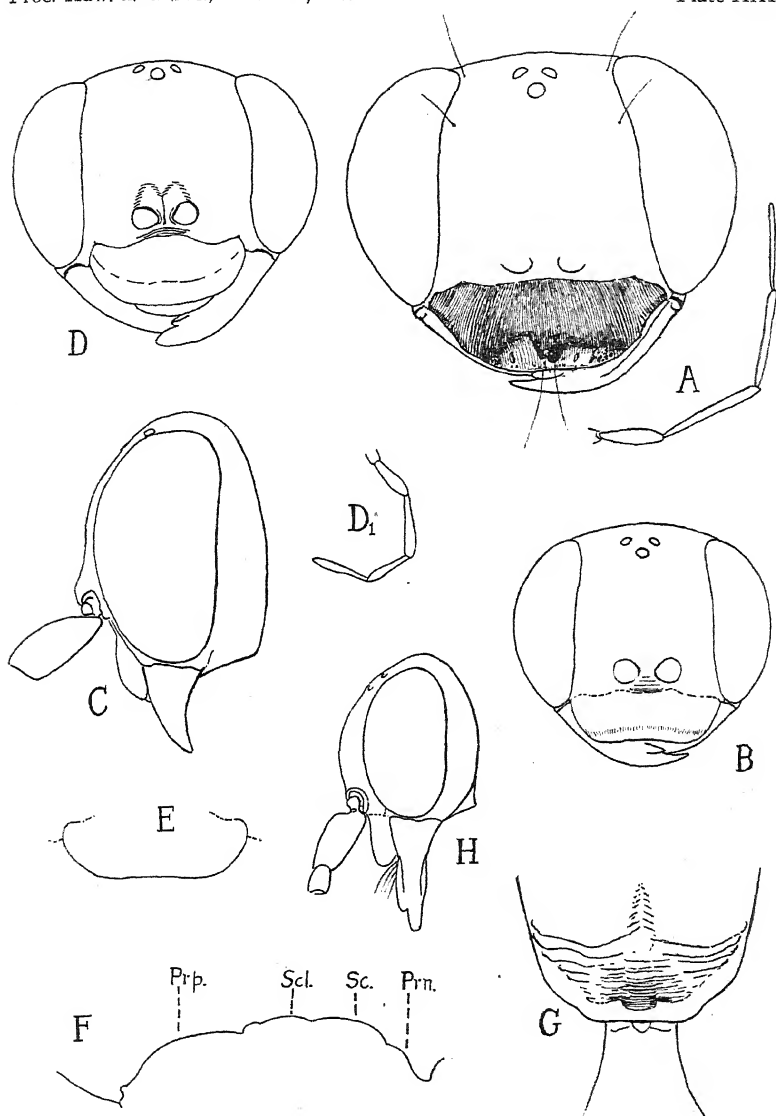


Fig. 9. A, *Priocnemis quodi*, female, pronotum in lateral view; B, *Priocnemis montrouzieri*; C, *Priocnemis umbrosicola*; D, *Priocnemis montrouzieri*, profile of abdomen. All figures to the same scale.

***Priocnemis quodi*** Vachal (pl. 21, figs. A and D; pl. 22, figs. C and E; text fig. 9 A)

Vachal, Rev. d'Ent., 26: 116, 1907. ♀.

The single specimen, a female, taken by me on a shrub in the Thi River valley, November 1, 1940, agrees fairly well with Vachal's short description. It is 14.5 mm. long, rather stoutly built, head and thorax matt black, abdomen subshining, legs except coxae, trochanters and apical tarsal joints reddish, wings orange with a heavy black band well beyond middle, a dark spot on basal vein extending along costa to base where it widens, outer margin of both wings narrowly blackish. Head in lateral profile showing raised antennal tubercles, clypeus broadly and shallowly excavate and not extending



## EXPLANATION OF PLATE XXII

- A—*Priocnemis umbrosicola*, head and last four joints of maxillary palpus.  
 B—*Priocnemis montrouzieri*.  
 C—*Priocnemis quodi*.  
 D—*Priocnemis araucariae*; D<sub>1</sub>, last four joints of maxillary palpus.  
 E—*Priocnemis quodi*, clypeus.  
 F—*Priocnemis umbrosicola*, profile of thoracic dorsum.  
 G—*Priocnemis umbrosicola*, apex of propodeum and base of abdomen, dorsal view.  
 H—*Priocnemis montrouzieri*.

beneath eyes; last three joints of maxillary palpi subclavate, only moderately lengthened. The propodeum has a wide shallow median fossa, a few strong transverse rugae and a shallow groove each side from the spiracle to apex, and as seen from above, the recurved propodeal flange each side just before the broad apical portion is simply rounded out. Hind tibiae above rather weakly serrate, hardly carinate; last tarsal joint of legs 2 and 3 beneath with one to several weak bristles each side of the median line before apex. Sericeous white pile locally on head, thorax and anterior portion of abdomen, velvety golden on apical half of tergite 3 and all of 4, 5 and 6, the integument beneath showing rufous. Quite sparse erect hair on head, thorax and coxae, a few short weak hairs on femora.

*P. quodi* and *P. araucariae* n.sp. may belong to Bank's subgenus *Clistoderes* (Proc. Amer. Acad. Arts & Sciences, 69: 33, 1934) erected for some Philippine *Priocnemis* that have a furrow on each side of the propodeum from the spiracle back to the end; they have a very large third submarginal cell, the second submarginal very oblique and the clypeus short, not reaching under the eyes.

***Priocnemis araucariae* n.sp.** (pl. 21, figs. F and G; pl. 22, figs. D and D<sub>1</sub>)

*Female*, type: Length 12 mm. Form stout. Black; femora, tibiae and first 2-3 joints of tarsi orange-yellow, the last tarsal joints brownish to black; mandibles with some deep red apically. Head and thorax rather opaque, the abdomen more shining; wings orange, forewings with a wide black band across beyond the middle length; the extreme wing base dusky and the subcostal vein darkened from the base to its junction with the basal cell and again just before the stigma. Clypeus broadly rounded, nearly truncate, last three joints of maxillary palpi moderately long and subclavate—as in *P. quodi*; antennae rather short, arising from tubercles, joint 3 longer than 4; eyes gently converging towards vertex, which is about equal to antennal joints 2 and 3; ocelli forming a low triangle, the posterior ocelli nearer to each other than to the eyes; no malar space. Pronotum emarginate subangularly posteriorly, and slightly depressed mesially there; propodeum rather evenly rounded, the disc with a faint median line from base and a wide shallow fossa gradually increasing in width to posterior face which is thereby very shallowly depressed; some transverse rugae laterally up to the fossa. Hind tibiae rather weakly serrate, the teeth subrescentric, each tipped with a small spine and about 10-11 in number; tarsal claws with one tooth beneath, the last tarsal joints pilose beneath and with occasional weak longer hair laterally beneath. Abdomen smooth, apical margin of tergites 5, and 6 (pygidium) pale, the 6th with an obscure median carina. Vestiture: general black pile; silver pile on clypeus, sides of face, posterior margin of pronotum and pronotal tubercles, posterior margin of mesonotum, a patch each side of scutellum and postnotum, coxae in part and mesopleurae, some on sides and distal end of propodeum, at base of tergite 1 laterally and weakly across 2, 5 and 6 with fine golden pile and with long brown hairs; a few erect hairs on head, coxae, etc.

New Caledonia: on an islet adjoining Yate near the southern extremity of the island in a region of *Araucaria cookii* pines, October 25, 1940 (F. X. Williams). Taken on the stem of a small tree. Evidently largely arboreal like its near relative *P. quodi*.

Differs from *P. quodi* Vachal in lacking the infuscation of the outer margin of the wings and the dark blotch found on the costal and basal area in *quodi*. In *araucariae* pale golden pile is present only on segments 5 and 6. The clypeus of the two species differ as figured. *P. quodi* has two or three short dark bristles beneath the last tarsal joints of legs 2 and 3. I suspect this character is variable in these species.

**Priocnemis montrouzieri** n.sp. (pl. 21, figs. C and C<sub>1</sub>; pl. 22, figs. B and H; text figs. 9, B and D)

*Female*, type: Length 10.2 mm. Moderately stout. Black; femora, tibiae and first one and two joints of tarsi orange-yellow; mandibles with some deep red apically. Head and thorax rather opaque, abdomen shining; wings orange, the forewings broadly infusate apically and with a second blackish band across the middle. Clypeus not extending under eyes, more arched transversely than convex, broadly truncate and shallowly emarginate, smoothly and rather widely shining along the margin; last three joints of maxillary palpi slender; antennae rather short, arising almost directly from frons, antennal joint 3 considerably longer than 4; eyes slightly converging towards vertex which at posterior ocelli is about equal to antennal joints 2 plus 3; ocelli forming slightly less than a right angle triangle—subequilateral. Pronotum posteriorly subangulately emarginate; propodeum gently rounded, opaque, almost coriaceous, very finely transversely striate reticulate and with only a trace of a wide fossa at apex; as seen from above the lower margin each side before apex slightly emarginate. Coxae and femora with sparse erect hair; anterior tibiae with a few spines along posterior lower side, midfemora with several irregular rows, hind tibiae with 3 rather well-defined rows of short spines the dorsal row of which is situated on a low ridge, each spine following a weak tooth, the whole more or less concealed by short orange pile. Tarsi more slender than in *P. araucariae*, the last joint beneath with pile only. Vestiture: fine appressed golden pile, dense on face, notal parts of thorax and the mesopleura, paler and thinner on propodeum; broad apical bands on tergites 1-5, cuneate mesad on 3-5, 6 with some reddish bristles apically where the integument is slightly reddish.

Type and three ♀ ♀ paratypes, Thi River valley, New Caledonia, November 8, 1940 (F. X. Williams). On ground in cut-over forest. One of the paratypes is 9 mm. long.

Named for Fr. P. Montrouzier who spent many years in New Caledonia where he collected and described many species of insects.

**Priocnemis umbrosicola** n.sp. (pl. 21, figs. B and H; pl. 22, figs. F and G; text fig. 9, C)

*Female*, type: Length 15.5 mm. Form slender. Black; femora, tibiae, first two joints of tarsi 1 and 2, first joint of posterior tarsus orange-yellow; mandibles with a little deep reddish apically; wings orange, primaries with broad blackish band beyond middle and joining the narrow apical band on outer margin, secondaries broadly blackish at apex; abdominal segments dull yellowish apically. Insect generally opaque, the tegument more or less concealed by sericeous pile, but the mandibles, margin of clypeus broadly mesad, and the abdomen beneath shining. Clypeus not extending under eyes, transversely arched, subtruncate and slightly bilobed, with a few large preapical and other bristles, some large punctures in the shining marginal area, while

mesad beginning just behind the margin and extending half way to the base of the clypeus is a rather large concavity; malar space very narrow, a mere strip; last three joints of maxillary palpi long and slender; antennae slender, arising from low tubercles, joint 3 considerably longer than 4 and somewhat longer than width of interocular space across posterior ocelli; ocelli forming an equilateral triangle. Pronotum emarginate subangularly posteriorly; scutellum well-elevated, the disc or flat portion narrowing posteriorly and there truncate; propodeum with transverse wrinkles, shallowly and rather widely sulcate mesad, the sulcation deepening apically, also a weak sulcus from spiracles to apex; as seen from above the subapical margin each side slightly emarginate. Legs long, rather weakly spinose, the posterior tibiae slightly carinate with a row of low weak teeth disappearing apically and each tipped by a small spine; in addition there are several rather poorly defined rows of small spines, all of which are somewhat concealed by dense pile; last joint of tarsi beneath with pile only. Abdomen petiolate though not as clearly so as in the *Pseudageninae*. Vestiture: dense golden pile in the usual places on head and thorax, thinner and more brassy yellow on propodeum, coxae and abdomen above; some golden pile at apex of segments, the abdomen above however, is generally more thinly clothed with very fine appressed pale brassy yellow pile producing a rather dull effect.

New Caledonia: Thi River valley, November 8, 1940 (F. X. Williams). On shady forest floor. One specimen. Apparently freshly issued.

This insect may fall into the American genus *Priophanes* Banks (Psyche, 50: 82, 1943; Bul. Mus. Comp. Zool., 94: 173-174, 1944) which contains species formerly placed in *Priocnemis*, but now separated from that genus because of the distinctly petiolate abdomen, no distinct beard under the head, the venation much like *Pseudagenia* and the hind tibiae with rows of spines and more or less distinct teeth which may be quite small. The elongate last three joints of the maxillary palpi and the relatively pointed lower side of the pronotal lobe further affiliate this New Caledonian species with the *Pseudageninae*.

### ***Priocnemis* ? *corynodes* Vachal**

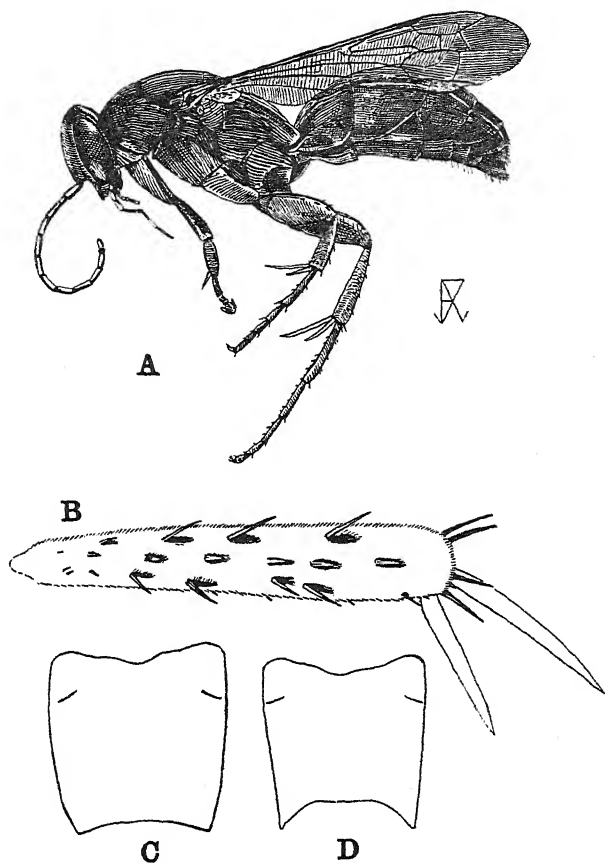
Vachal, Rev. d'Ent., 26: 116-117, 1907. ♂.

I have not seen this insect which Vachal places with doubt in the genus *Priocnemis*. The type is a male. It is 12-13 mm. long, black with bottle-green reflection, the tibiae and tarsi of the first pair of legs more or less reddish; wings hyaline, the primaries with two brownish bands, the secondaries brownish apically. Abdomen pedunculate as in the genus *Icaria* (Vespididae). The legs appear to be lightly spined.

### ***Homonotus ariadne* (Cameron) ? (pl. 23, figs. A, B and C, ♀)**

*Pompilus* (*Ferreola*) *ariadne* Cameron Mem. and Proc. Manchester Soc. (4) 4: 457, 462, pl. 3, figs. 7, 7 a, 1891.

*Pompilus ariadne* Cam. Bingham, Fauna of British India, Hymenoptera 1, Wasps and Bees: 159, 1897. ♀.



EXPLANATION OF PLATE XXIII

- A—*Homonotus ariadne* (?), female. Noumea, New Caledonia.  
B—*Homonotus ariadne* (?), female; posterior tarsus, dorsal view. Noumea, New Caledonia.  
C—*Homonotus ariadne* (?), female; propodeum, from above. Noumea, New Caledonia.  
D—*Homonotus tagalicus*, female; propodeum, from above. Los Baños, Philippines.



New Caledonia: Noumea, 7 ♀♀ and 1 ♂, July, August and September 1940; St. Louis, 1 ♂, August 26, 2 ♀♀ and 1 ♂, October 14, 1940 (F. X. Williams).

I determine this wasp with some doubt as the rather widespread oriental *H. ariadne*. The largest New Caledonia female is 9.5 mm. long. It is black with silvery pile, while the wings are nearly transparent, being faintly clouded apically. From its near relative, *H. tagalicus* Banks of the Philippines (pl. 6, fig. D, ♀) it differs chiefly in having the angles of the propodeum less prolonged behind. The wings are generally more hyaline, and there may or may not be a stub of a vein on the basal side of the base of the first submarginal cell.

My notes on this wasp indicate that it is found on shrubs and weeds.

The genus *Homonotus* is considered by Banks (The Psammocharidae of the Philippines, Proc. Amer. Acad. Arts & Sci., 69:109, 1934) as the most highly developed of the family Pompilidae, in its flattened head with the very concave occiput, elongate pronotum and the propodeum with the angles prolonged behind.

#### **Aglochaes vachali** Banks (text fig. 10)

Banks, Bishop Mus. Occ. Papers, 16:245, fig. 1, a. "Two females from New Caledonia, Houailou, Sept. 25, 1925, Oct. 28, 1925, Ford".

Banks erected the genus *Aglochaes* for this single species. Of *Aglochaes* he says in part: "Readily separated from *Ctenostegus* by the smooth last tarsal joint".

New Caledonia: Noumea, 1 ♀, September 17, 1 ♀, November 4, 1 ♂, September 29, 1 ♂, November 9; St. Louis, 1 ♀, October 14; Thi River valley, 1 ♀; Oua Tom, 2 ♂♂, September 19 and 20; Hienghene, 1 ♂, October 4, 1940 (F. X. Williams).

This wasp attains a length of about 10.5 mm.; it is blackish, banded and otherwise marked with silvery pile, the wings hyaline with two brownish bands, the outer one somewhat double, the apex conspicuously white, secondaries have the apex infuscate. The male has the antennae with a broad strip of very short erect hair on the underside; the posterior margin of the pronotum is very narrowly white though overlaid by silvery pile; the posterior tibiae above at their base have the silvery pile more intense than elsewhere, and the 7th tergite is creamy whitish.

#### **Pompilus** sp. (near *P. lascivus* Cameron [1891] and *P. philippinensis* [Banks] [1934])

New Caledonia: Prony Bay, October 22, 1940; 2 ♀♀ found dead and slightly digested, among other insects, in the pitcher-like leaf of a species of terrestrial *Nepenthes* plant. In the liquid contained in these pitchers the larvae and pupae of a mosquito (*Trip-*

*teroides caledonica* [Edwards]) were found, and the adults reared. A specimen of what seemed to be this pompilid was seen but not taken near the shore at the Isle of Pines, October 23 (F. N. Williams).

It is about 10 mm. long; black, the head except clypeus and mandibles in part, pronotum, scutum, scutellum and postscutellum

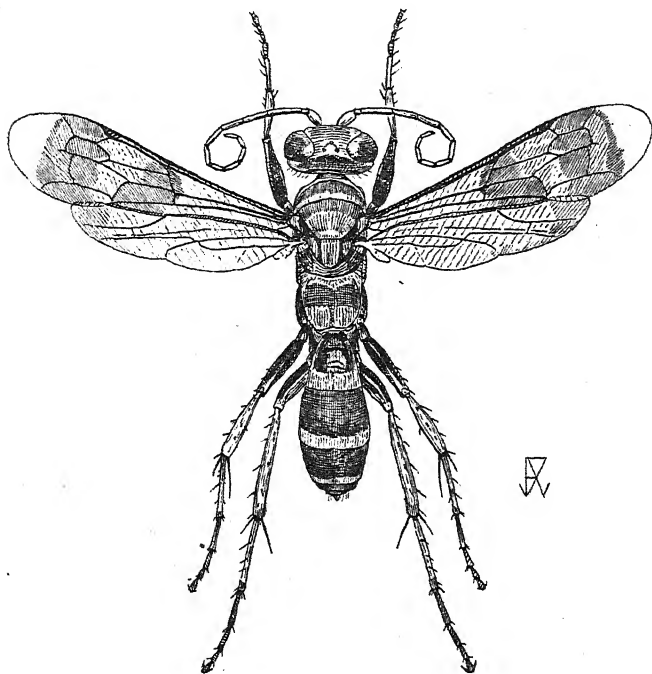


Fig. 10. *Aglochores rachali*, female. Length 7.5 mm.

reddish, wings fuscous; in the forewings the transverse-median and the basal veins are interstitial or nearly; in the hindwings the anal vein ends well before the cubital fork. *Pompilus lascivus* Cameron, Mem. & Proc. Manchester Soc., (4)4:475, pl. 3, fig. 26, 1891, is an Indian species and is also found in Ceylon. I have not seen the original description of this wasp. *Pompilus philippinensis* (Banks) (The Psammocharidae of the Philippines, Proc. Amer. Acad. Arts & Sci., 69:92-93, 1934) is rather widespread in the Philippines.

**Pompilus elatus** Smith (text fig. 11)

Smith, Jl. Linn. Soc. Zool., 8: 82, no. 5, ♀, 1864. Asia: Morty Island.

*Pompilus inquirendus* ♀, ♂ "(an *P. opulentus*, Sm. ?)" Vachal, Rev. d'Ent., 26: 117, 1907. New Caledonia.

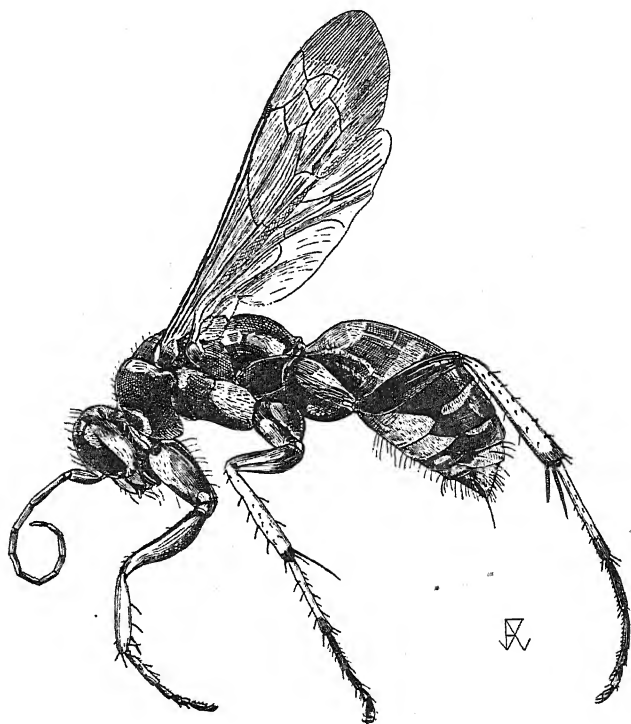


Fig. 11. *Pompilus elatus*, female. Length 11.5 mm.

New Caledonia: 1 ♀, 1940; Noumea, 3 ♀♀, July 6, 1 ♂, August 10; St. Louis, 3 ♀♀, August 17, 1 ♂, October 27; Oua Tom, 2 ♀♀ and 1 ♂, September 19 and 20; Nepoui Valley, 1 ♀ and 3 ♂♂, August 6; Isle of Pines, 1 ♀, October 23, 1940 (F. X. Williams).

I have only seen Vachal's description of the synonym, *Pompilus inquirendus* taken in New Caledonia. My specimens measure from 7.5 mm. in the male to 12 mm. in the female. It is blackish adorned with patches of silvery pile, and the wings are subhyaline except the apex broadly, and a part of the marginal cell, which are in-

fuscate. The fore tarsal comb is not well-developed, and there is an obscure protuberance or short rounded ridge each side at the beginning of the slope of the propodeum.

Turner (Trans. Ent. Soc. London: 73, 1917) gives additional records as Queensland and Moluccas; and (ibid: 340, 1919) also lists Fiji and New Caledonia.

#### AMPULICIDAE

##### ***Ampulex compressa* (Fabr.) (text fig. 12)**

*Sphex compressa* Fabricius, Spec. Insect., 1: 445; n. 19, 1781.

This brilliant blue green wasp, the "cantharide" in New Caledonia, measures up to nearly an inch in length. Its original home is the warmer portions of Asia, but it has spread, probably largely

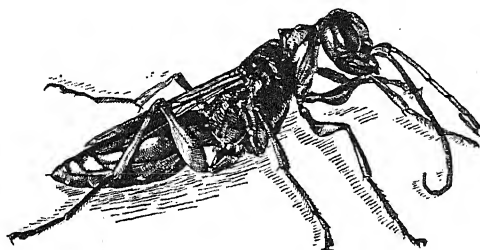


Fig. 12. *Ampulex compressa*, female.

through the agency of shipping, to Mauritius, East Africa and to New Caledonia. Inasmuch as it preys upon cockroaches of the genus *Periplaneta*, themselves inveterate travellers, it is easy to explain the wide distribution of this rather domiciliary wasp. It is very well known in New Caledonia where it is common enough from October to perhaps March or April. Late in 1940 the writer imported it into Hawaii where it is now abundant.

It has been known in New Caledonia since at least 1879, when Lucas refers to the cocoon of *Ampulex* as encased in the remains of *Blatta americana*. It is also mentioned by Turner in 1919, and by others.

#### SPHECIDAE

##### ***Chlorion (Proterosphex) fumipennis* (Smith)**

*Sphex fumipennis* Smith, Cat. Hym. Brit. Mus., 4: 249, 1856, ♂ ♀.

New Caledonia: Noumea, October 16, 2 ♂ ♂; Isle of Pines, October 24, 1940. One specimen seen at Nakety, on the east coast, October 9 (F. X. Williams). At Noumea the specimens were taken

at the edge of a small decrepit forest in the hills behind the town where they were flying about the crown of a flowering bush.

A large black wasp with dusky wings showing purple iridescence.

Widely distributed in Australia and occurring in the New Hebrides (= *Sphex antennata* Sm.).

*Sphex rouxi* Schulthess (Nova Caledonia, Zool. 2[1]: 47-48, 1915) with dark-margined, yellowish wings, said to be related to *S. formosus* Sm. was described from the New Hebrides and Loyalty Islands. I presume it is a *Chlorion*.

### **Sceliphron hemipterum (Fabr.)**

*Sphex hemiptera* Fabricius, Entom. System. Suppl.: 244, n. 11-12, 1798.

New Caledonia: St. Louis, October 14, 1940, 3 ♂♂; October 29, 1 ♂, 1 ♀ (F. X. Williams). A dusky mud-dauber, 20-25 mm. long; blackish with dull brownish red on the clypeus, base of antennae, mandibles and a blotch on the side of the thorax. The wings are very dilute yellow.

The wasp was coming into season in October, when males were seen flying over bushes evidently searching for females. Old cell masses of this wasp were found in hollow trees, on banks and in very large numbers on the ceiling of an old mill shed at St. Louis.

Recorded also from Madagascar, Mauritius and the Seychelles.

### TRYPOXYLONIDAE

Vachal (1907) lists the Australian *Pison punctulatum* Kohl ♂ with doubt, from New Caledonia, and describes *Pison strictifrons* ♀ from that locality.

R. E. Turner (1919: 239) lists *Pison rechingeri* Kohl (1908) described from Samoa, from Noumea, New Caledonia adding: "This is probably the species identified by Vachal with doubt as *P. punctulatum* Kohl." *P. rechingeri* is regarded by Perkins and Cheesman (Insects of Samoa, 5, Hymenoptera: 26-27, 1928) as a synonym of *Pison tahitense* Saussure (1867).

The present collection contains five species of *Pison*, which I have determined as follows:

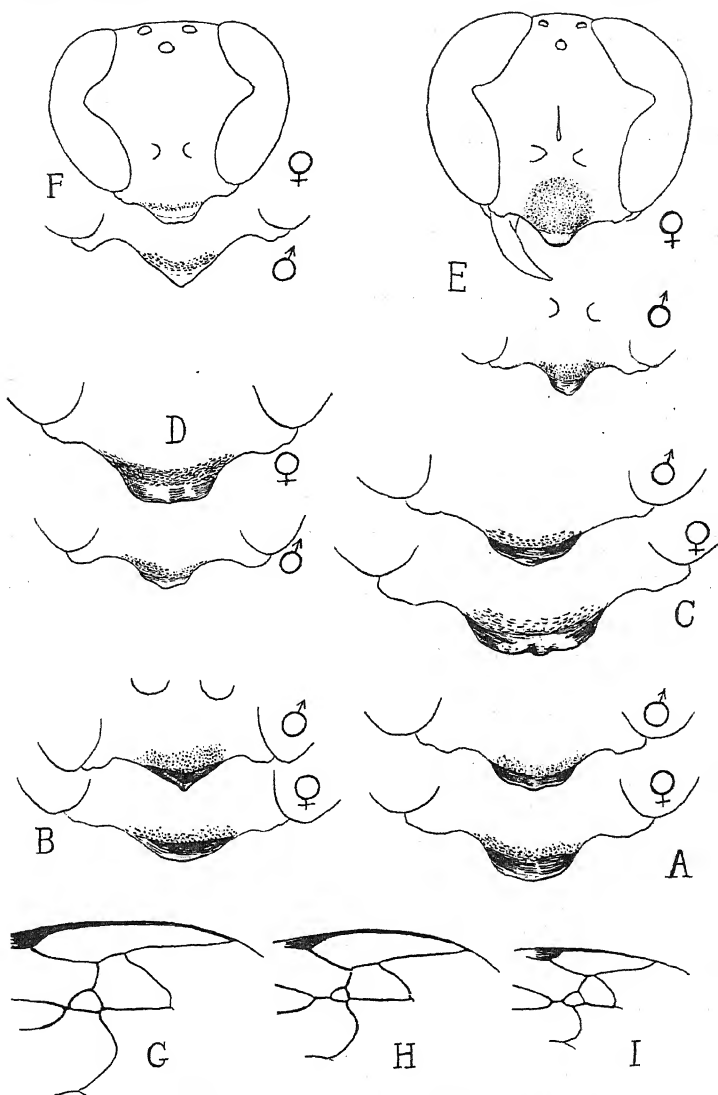
### **Pison (Pisonitus) rufipes Shuckard (pl. 24, figs. F and I)**

Shuckard, Trans. Roy. Ent. Soc. London, 2: 79, 1837, ♀, Tasmania (Van Diemen's Land).

New Caledonia: Noumea, August 10, 1940. 3 ♂♂ and 3 ♀♀, by stagnant pool, at sea level (F. X. Williams).

A pair taken by me at Sydney, Australia in March 1919, differ in no way from the New Caledonian specimens.

I refer this wasp doubtfully to *P. rufipes*, as Shuckard's description is very short.



EXPLANATION OF PLATE XXIV

- A—*Pison* sp., clypeus.  
 B—*Pison strictifrons*.  
 C—*Pison ignazum*.  
 D—*Pison argentatum*. From Hawaii.  
 E—*Pison insulare*.  
 F—*Pison rufipes* (?).  
 G—*Pison insulare*, female; extremity of forewing.  
 H—*Pison insulare*, male.  
 I—*Pison rufipes* (?), male.

It measures up to about 7 mm. long; for the most part it is finely opaque, the mandibles, antennae in part, apex of clypeus, particularly in the ♀, and the legs except the coxae and trochanters are reddish, the apex of the segments of the abdomen are testaceous; the pile is silvery, in part with a pale brassy lustre. The interocular space at the vertex is noticeably wider than at base of the clypeus. The first recurrent nervure is received towards the apex of the first submarginal cell and the second recurrent at about the middle of the second submarginal cell (wing characters also of *P. ignavum* and *P. sp.*, following).

**Pison strictifrons** Vachal (pl. 24, fig. B; pl. 25, figs. B, D and F)

Vachal, Rev. d'Ent., 26: 114-115, 1907, ♀.

New Caledonia: Noumea, St. Louis, Oua Tom, Touho. August, September, October and November 1940. Eleven males and 8 females (F. X. Williams). One of the males was reared from a free nest of mud cells.

A species of medium size, all black including the spurs; the sculpture is fine, the clypeus of the female gently rounded out, that of the male drawn to a point; posterior ocelli very close to the eyes; disc of propodeum nearly smooth, with a fine median carina from which, and from the base of the disc, proceed fine diverging but abortive striae. There is no transverse impressed line behind the posterior ocelli.

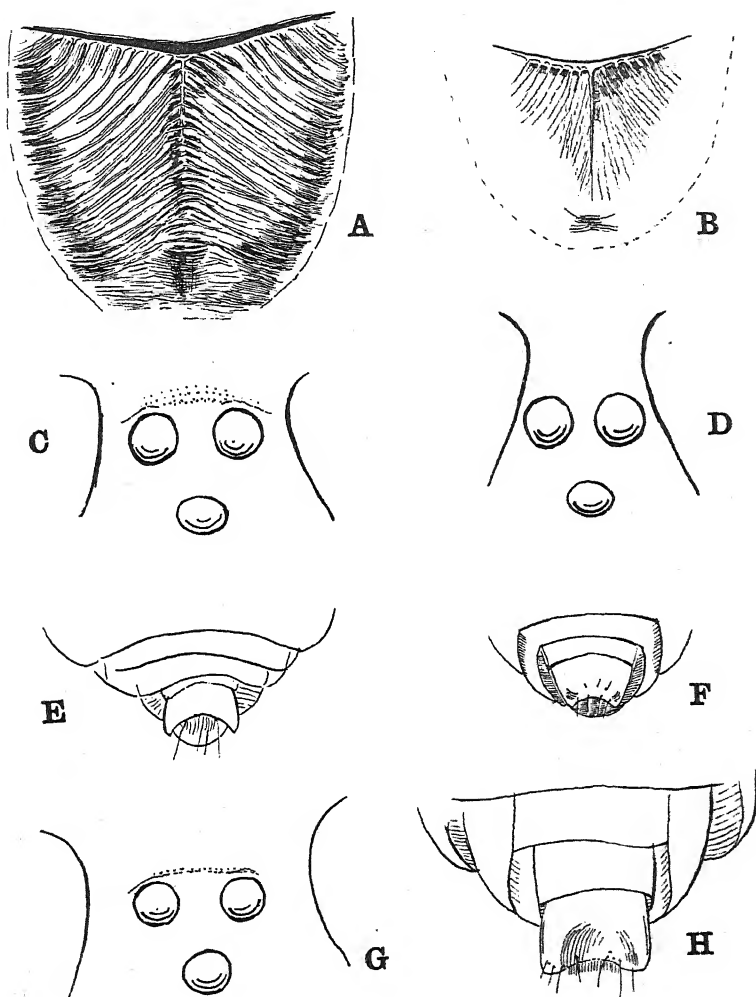
**Pison ignavum** Turner (pl. 24, fig. C; pl. 25, figs. E and G)

Turner, Proc. Zool. Soc. London: 511-512, 1908 ♂ ♀ Queensland; Melbourne, Australia.

New Caledonia: Noumea; St. Louis; 25 miles NW of Noumea; S. New Caledonia. Twelve ♀ ♀ and 8 ♂ ♂, October 1940.

Considered by Turner (1908), and by Perkins and Cheesman (1928) as a subspecies of *P. argentatum* Shuckard. "Distinguished from *argentatum* (Mauritius, Honolulu) by the slightly more rounded clypeal apex in the ♂" (Cheesman, A Contribution towards the Insect Fauna of French Oceania: 177, 1928 [re The Marquesas and Society Islands]); and—"The median segment in *ignavum* is more strongly striated than in the more typical form, but the difference is not sufficient to be of full specific value" (Turner, Proc. Zool. Soc. London: 355, 1910). Further distinctions between the two species were pointed out by me in 1932. Specimens of *P. ignavum* from Samoa as determined by Perkins and Cheesman correspond exactly to my New Caledonian specimens. I have also seen *ignavum* from Queensland. Both species have a more or less well-defined impressed subsinuous line extending behind the posterior ocelli.

As in *P. argentatum*, *P. ignavum* constructs free cells of mud pellets and sometimes hangs them from rootlets exposed in a bank.



# EXPLANATION OF PLATE XXV

- A—*Pison* sp., male; propodeum, dorsal view.
- B—*Pison strictifrons*, propodeum.
- C—*Pison* sp., female; ocelli, from above.
- D—*Pison strictifrons*, female.
- E—*Pison ignavum*, male; apex of abdomen, from beneath.
- F—*Pison strictifrons*, male; apex of abdomen, from beneath.
- G—*Pison ignavum*, female; ocelli, from above.
- H—*Pison insulare*, male; apex of abdomen, from beneath.



**Pison insulare** Smith (pl. 24, figs. E, G and H; pl. 25, fig. H)

New Caledonia: Noumea, St. Louis, Thi River valley, Prony Bay, Isle of Pines, Oua Tom, Bonjou district, Nepoui, Nakety and Hienghene; 26 ♂♂ and 26 ♀♀ 1940 (F. X. Williams). Of these one male was reared from a mud cell of *Eumenes germaini* which the mother *Pison* had partitioned into two cells.

The largest of the New Caledonian *Pison* taken by me, females measuring up to 11 mm. long. The posterior ocelli are much less than half their diameter from the eyes and about half their diameter from each other. The disc of the propodeum is shining, with scattered punctures, a more or less developed median furrow and obsolescent transverse and oblique striae.

Miss E. L. Cheesman (Ann. Mag. Nat. Hist., [10] 20: 203-204, 1937) who collected *Pison insulare* in the New Hebrides, supplements Smith's brief description of this wasp with useful descriptive notes of her own.

**Pison** sp. (pl. 24, fig. A; pl. 25, figs. A and C)

A semi-opaque species with fine puncturation but with the disc of the propodeum rather coarsely sculptured, the carina being placed in the somewhat of a fossa. The incised line behind the posterior ocelli does not extend across the vertex.

Seven ♂♂ and 3 ♀♀, (1 ♂ from Nakety, October 10) the rest from Noumea, September, October and November, 1940 (F. X. Williams).

#### LARRIDAE

**Liris clypeata** (Smith) (pl. 26, figs. A-D)

*Larrada clypeata* Smith, Ann. Mag. Nat. Hist., (4) 12: 294, 1873. ♀. New Caledonia.

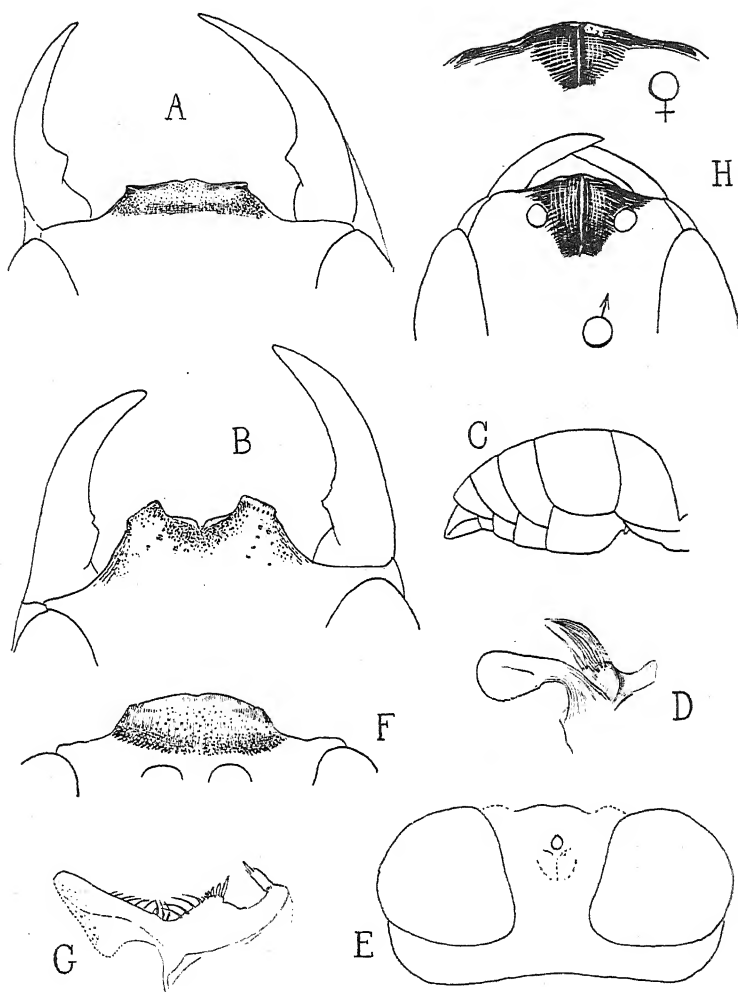
*Larra clypeata* (Sm.) Kohl, Verh. zool.-bot. Ges. Wien, 34: 242, 1884.

*Notogonia clypeata*, Sm. Turner, Ann. Mag. Nat. Hist. (9) 3: 239, 1919. ♂. Noumea, New Caledonia. "Also from Api, New Hebrides."

*Liris* (*Larrada*) *clypeata* (Sm.) Cheesman, Ann. Mag. Nat. Hist., (10) 20: 204-205, 1937. Describes ♂.

5 ♀♀ and 3 ♂♂, New Caledonia: Noumea, 3 ♀♀, July and October, 1940; St. Louis, 1 ♀, August, 1940, Thi River valley, 1 ♀, November, 1940; Prony Bay, 2 ♂♂, October, 1940; Hienghene, 1 ♂, October, 1940 (F. X. Williams).

A stout, moderately shining black wasp measuring to about 16 mm. long. The female is easily recognized by the deeply cleft clypeus, an exaggeration of the condition found in such species as *L. melania* Turner from Queensland, *L. mindanaoensis* Williams from



## EXPLANATION OF PLATE XXVI

- A—*Liris clypeata*, male; clypeus.  
 B—*Liris clypeata*, female; clypeus.  
 C—*Liris clypeata*, female; abdomen in lateral profile.  
 D—*Liris clypeata*, male; sagitta of aedeagus, lateral view.  
 E—*Liris clypeata*, female; head, from above.  
 F—*Notogonidea manilae*, female; clypeus.  
 G—*Notogonidea manilae*, male; sagitta of aedeagus, from above.  
 H—*Nitela austrocaledonica*, clypeus.

the Southern Philippines, and *L. samoensis*.\* It further resembles the above species in the narrow vertex, the absence of spines on the fore tibiae above, and in the rounded propodeum, but possesses a rather ample occipital region, which is characteristic of such species as *L. aurata* (Fabr.) and *L. haemorrhoidalis* (Fabr.) of oriental regions.

*Liris clypeata* is a wary insect, not readily taken.

**Notogonidea manilae**\*\* (Ashmead) (pl. 26, figs. F and G)

*Notogonia manilae* Ashmead, Proc. U. S. Nat. Mus., 28: 130, 1905. ♂, ♀. Manila, Philippines.

*Notogonia retiaria* Turner, Proc. Zool. Soc. London, 31: 479-480, 1908. Perth, W. Australia; Kuranda, Queensland, Australia (1916); Fiji (1918).

*Notogonidea williamsi* Rohwer; Ent. Ser. Bul. 14 (1), Exp. Sta. Hawaiian Sugar Planters' Assn.: 9-10, 1919. Los Banos, Luzon.

*Notogonidea manilae* (Ashmead). Williams, Ent. Ser. Bul. 19, Exp. Sta., Hawaiian Sugar Planters' Assn.: 75-76, 100, 1928.

*Notogonidea retiaria* (Turner). Williams, Insects of Samoa, 5, Hymenoptera, (1): 33-34, 1928.

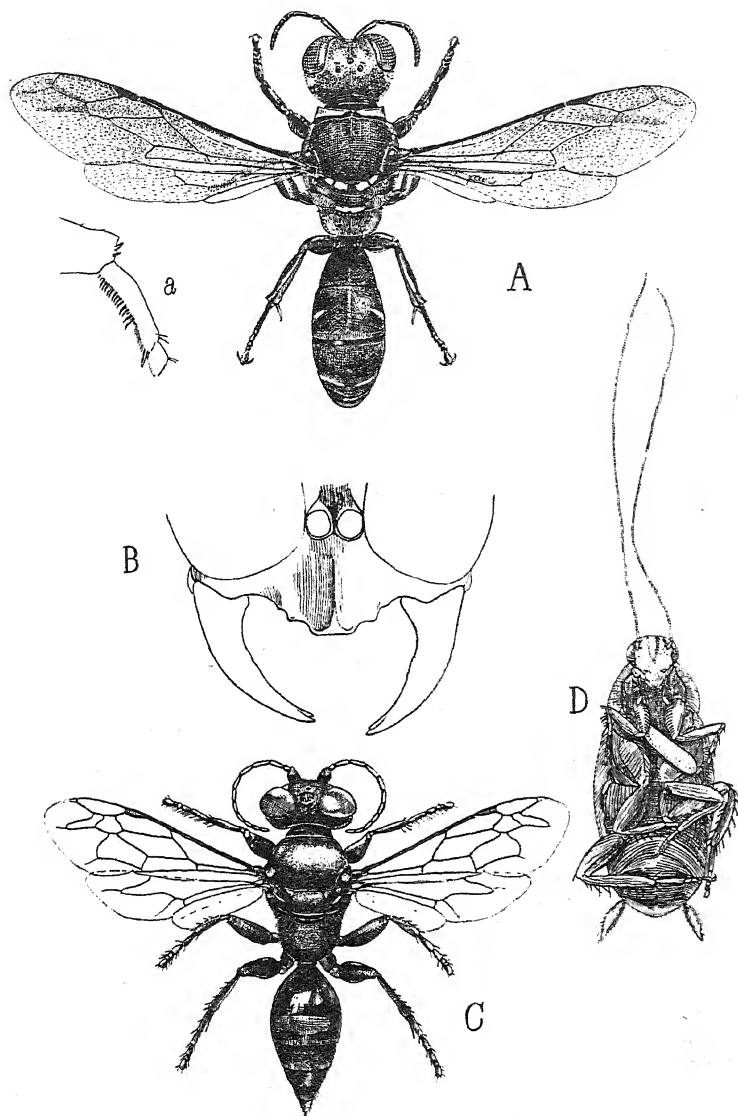
*Notogonidea retiaria*, Cheesman, Ann. Mag. Nat. Hist. (10) 20: 206, 1937.

After a critical study of specimens of this wasp from Australia, Fiji, Samoa, New Caledonia, the Solomons, and the Philippines, where it is very abundant, I have come to the conclusion that *N. retiaria* is a synonym of *N. manilae* (Ashmead).

It is a variable species, quite common in New Caledonia and perhaps a recent arrival there, appearing not to have previously been recorded from that island. In the Philippines I found *N. manilae* storing its burrow with *Nemobius histrio* Saussure, a tiny cricket. In the rather decrepit Thi River forest, New Caledonia, it was observed preying likewise upon small crickets. Here on November 8, attentively following prey-laden wasps to their burrows, was a relatively large muscoid fly of tribe Miltogrammini, family Stephanosomatidae. This fly probably deposits its own young on the

\**Liris corniger* Williams (Ann. Mag. Nat. Hist. [10] 18: 126-128, 1936) described from a single female from the British Solomon Islands belongs in the *L. melania* group, its toothed clypeus notwithstanding. The strong median clypeal tooth of *corniger* may possibly be a malformation since the insect, a fresh specimen, was received with the face stove in, and such an injury, did it occur in the pupa or teneral adult, might demand a compensating outpushing elsewhere.

\*\*I am using *Notogonidea* Rohwer rather than *Motes* Kohl, as proposed by Pate (The Generic Names of the Sphecoid Wasps and their Type Species. Mem. Am. Ent. Soc., 9: 41, 92-95, 1937) and later used by him (Can. Ent., 75: 200-202, 1943). I have not seen Arnold's review of the genus *Notogonidea* in his monograph of the South African Sphecidae (Ann. Transvaal Mus., 9: 228 et seq., 1923) to which Pate refers. These two authors do not consider that *Motes* and *Notogonidea* are generically distinct and Pate uses the older (*Motes*) of the two names. I think that *Motes* and *Notogonidea* should be retained as full genera. They appear readily separable. To unite *Motes* and *Notogonidea* into one genus would, in my opinion, give equal reason to include both of these names as synonyms of *Liris* of Fabricius (1804), or perhaps to go still further, and thus to form a still more unwieldy genus and to add unnecessarily to the ever-growing literature on synonymy.



# EXPLANATION OF PLATE XXVII

A—*Crabro novocaledonicus*, male type; a, basal midtarsal joint, from side (paratype).

B—*Crabro novocaledonicus*, male; clypeus.

C—*Tachysphex fanuiensis*, female. Length 9 mm. New Caledonia.

D—Cockroach, mature female, heavily shaded to show egg of *Tachysphex fanuiensis*. Length of cockroach, 6.75 mm.; of wasp egg, about 2 mm. New Caledonia.

wasp's prey. Miss Cheesman (1937) also reports this species (under *N. retiararia*) from the New Hebrides.

***Tachysphex fanuiensis* Cheesman (pl. 27, figs. C and D)**

*Tachysphex fanuiensis* Cheesman. Ann. Mag. Nat. Hist., (10) 1: 172-175, 1928. fig. 2, A and B. (♂ ♀). Tuamotu Archipelago; Society Islands.

Williams, Bishop Mus.; Pac. Ent. Survey, Bul. 98, Marquesan Insects—I: 150-151, 1932.

The discovery of this little black wasp in New Caledonia extends its range far to the west. The material consists of 7 ♂♂, all from the Isle of Pines, October 24, 1940, and 8 ♀♀, of which 2 are from the Isle of Pines, October 24, 1940, 1 from an islet near Yate, October 25, 2 a few miles north of Mount Mou, September 13, 1940, 2 from Noumea, October 30 and November 5, 1940, and 1 from the east coast, October 7, 1940 (F. X. Williams).

Notes on this 6-10 mm. long wasp are in part as follows: September 13, near the native village of Bonjou, some kilometers north of Mount Mou, I netted a heavily burdened little wasp that was flying over a stream. She proved to be a *Tachysphex* and her burden a tiny, though mature cockroach that, save for a slight movement of the palpi, had been stung to immobility. Pursuing my search along the stream side, a second *Tachysphex* was noted filling up her burrow in the coarse sand at the base of a bank. She was throwing in sand with her hind legs, varying this procedure by turning about to work with her head. She was captured and the shallow burrow dug up, bringing to light 13 small cockroaches, all one species, of which but one was immature. They were about 7 mm. long. Most were females, which possessed shorter wings than the males; the majority had an egg capsule more or less extruded from the end of the body. This lot had probably occupied two cells, as two of the victims had a *Tachysphex* egg about 2 mm. long glued at one end to the body behind a fore coxa, the egg extending obliquely posterad. (pl. 10, fig. D). Another *Tachysphex fanuiensis* was captured in a garden in Noumea, where she was provisioning her burrow with an adult of this cockroach.

Miss Cheesman (t. c.: 174-175) first discovered this wasp preying on cockroaches, as follows: "On the coast-hills above Fanui several females were making their burrows on patches of dry soil, and stocking them with a small cockroach, *Blattella notulata* Stål (described from Tahiti by Br. von Wattenwyl under the name of *Phyllodromia hieroglyphica*)"—This cockroach has been more recently determined by Morgan Hebard as *Graptoblatta notulata* (Stål) (Bishop Mus. Bul. 114, Marquesan Insects—II: 117, 1935). As Miss Cheesman remarked, this blattid has the habit of sitting openly on leaves. The cockroach prey of *Tachysphex fanuiensis* in

New Caledonia except for its smaller size much resembles *Graptoblatta notulata*.

***Nitela austrocaledonica* n.sp.** (pl. 26, fig. H, and text fig. 13)

*Female*, holotype: Length 4.5 mm. Black; head and thorax rather opaque, abdomen smooth and shining; tip of mandibles red, tegulae and axillary sclerites dark brownish, extreme apex of tibiae, their spurs, and tarsi except apical joints, yellowish brown. Mandibles with a small tooth above near the apex; clypeus somewhat produced and very slightly emarginate mesad, the disc with a sharp carina to margin; base of the antennae farther from each other than from the eyes, joints 2 and 3 subequal and together about equalling the interocular space at the vertex; ocelli forming a nearly equilateral triangle, posterior ocelli very close to the eyes, being distant from them by less than their diameter and clearly more than twice as far from

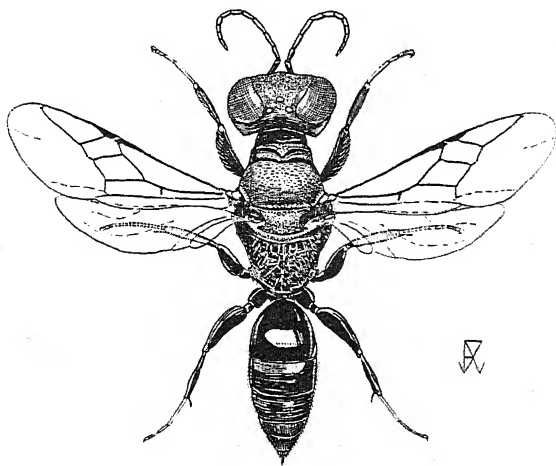


Fig. 13. *Nitela austrocaledonica*, female. Length 4.5 mm. Noumea, New Caledonia.

each other than from the eyes; frons very finely striolate-reticulate. Pronotum rather narrow, the humeral angles not prominent; very finely transversely striate, with a transverse and somewhat reticulate groove more depressed mesad where it is interrupted by a wedge-like projection. Mesonotum finely reticulate, with transverse striolae, a large pit in the shining mesopleural area. Scutellum with about nine basal foveae, the median pair relatively large, the disc somewhat longitudinally striolate-punctate. Propodeum wider than long, as seen from above tapering and rounded-truncate apically, the disc with rather large reticulations formed on more or less longitudinal carinulae, the sides of the propodeum longitudinally, the posterior face transversely striate with a shallow groove. Venation normal for the genus. Vestiture: sparse silvery pile.

*Male*, allotype: Length 3.75 mm. Like the female, but the median portion of the clypeus is not at all emarginate, the mandibles are simple, and the sides and posterior face of the propodeum are reticulate-striate.

Holotype, allotype and 2 ♀♀ and 2 ♂♂ paratypes, Noumea, New Caledonia, end of October, 1940 (F. X. Williams). Taken on the sunlit trunk of a palm tree in a garden.

This species seems closest to *Nitela kurandae* Turner (Proc. Zool. Soc. London, 2: 508, 1908), from Cairns, Queensland, which I have not seen. It agrees pretty well with the description of *kurandae* in clypeal and ocellar characters and differs from that Australian species in being nearly all black, whereas *kurandae* has the antennae in part, and all the legs pale ferruginous.

#### CRABRONIDAE

##### *Crabro novocaledonicus* n.sp. (pl. 27, figs. A and B)

*Male*, type: Length 10 mm. Black; head and thorax opaque, abdomen subopaque above, shining beneath; scape except a line beneath, humeri of pronotum widely, pronotal lobes, paired spot each side on scutum anteriorly, wide spot on scutellum, stripe on fore femora beneath, small spot on fore tibiae above at base, mid femora in part above anteriorly and beneath, stripe on middle and hind tibiae above, and each side on tergite 2, an interrupted band at about middle length on tergite 5, a complete band on 6 and 7, yellow; wings in part infuscate, most pronounced on the anterior half or more of the primaries. Head and thorax generally coriaceous—with fine very close punctures. Head subquadrate; mandibles of about uniform width on exterior face, bidentate but without a distinct tooth on upper inner margin; clypeus doubly truncate, with a strong median carina that widens at the margin; antennae with 13 segments, not modified, antennal fossae contiguous, joint 3 of antennae at least twice as long as 4; eyes converging strongly towards clypeus, face excavate and with a median impressed line; ocelli in a low triangle, the posterior ocelli farther from each other than from the eyes. Pronotum sulcate mesad, the humeral angles acute, the anterior margin thinly raised, the pleura wrinkled, compressed to form with the sharply margined mesopleura an epicnemium or bed for the anterior femora. A vertical carina before the middle coxae. Propodeum short, the disc rather poorly defined, with a narrow median groove, posterior face oblique, sulcate. Femora stout, first four joints of anterior tarsi flattened and about twice the normal width; the fore tibiae and first tarsal joint fringed with pile anteriorly; middle tibiae without definite apical calcar; first joint of middle tarsi somewhat arched, with a fringe of stout little bristles outwardly beneath (Aa). Wings long, the recurrent vein in outer third of submarginal cell. Abdominal tergites finely coriaceous, the first segment long, subpetiolate, its apex considerably narrower than the base of 2; segment 1, and 2 in part, keeled laterally, sternites 2 and 3 mainly flat, those beyond becoming gently concave; pygidium rugulose; apex with a pair of small diverging papillae.

Type and 3 ♂♂ paratypes, New Caledonia: hills behind Noumea, October 16 and 19, 1940 (F. X. Williams). Flying about a flowering shrub, evidently searching for females.

This insect best fits Kohl's species-group *Crabro* (Die Crabronen der Paläarktischen Region. Ann. k. k. Naturhist. Hofmus. Wien, 29: 21-23, 1915), or the genus *Ectemnius*, its approximate equivalent (see Pate's Conspectus of the Genera of Pemphilidinae Wasps [Hymenoptera: Sphecidae. American Midland Naturalist, 31: 329-384, 1944]). The New Caledonian species is in the same

group as our Hawaiian *Crabro*, which however have the antennae 12-jointed in the male as well as in the female.

#### OTHER INSECTS

The New Caledonian bull-dog ant (*Myrmecia apicalis* Emery [1883] Ponerinae)

This is a large slender finely sculptured black ant (text fig. 14), with the bilobed labrum, the flagellum of antennae in part, mandibles

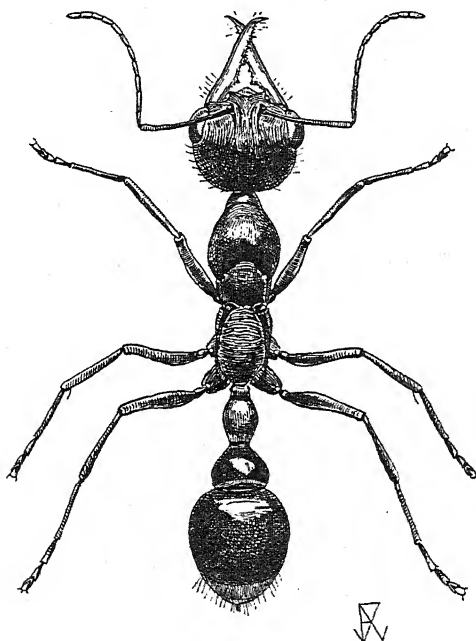


Fig. 14. *Myrmecia apicalis*. Length 11.5 mm. Marmite forest, New Caledonia.

except teeth and apex, yellowish, the labrum and apex of abdomen being submetallic and covered with pale brassy pile and the body in general with fine white pile giving it a pruinose appearance. For the genus it is of rather small size—up to about 12 mm. long—some of its Australian relatives attaining a length of 25 mm. or more. I have not seen Emery's description.

I took a half-dozen specimens of this apparently timid species on shrubs in the cut-over Marmite forest, in the mountains beyond the St. Louis mission, in November 1940.



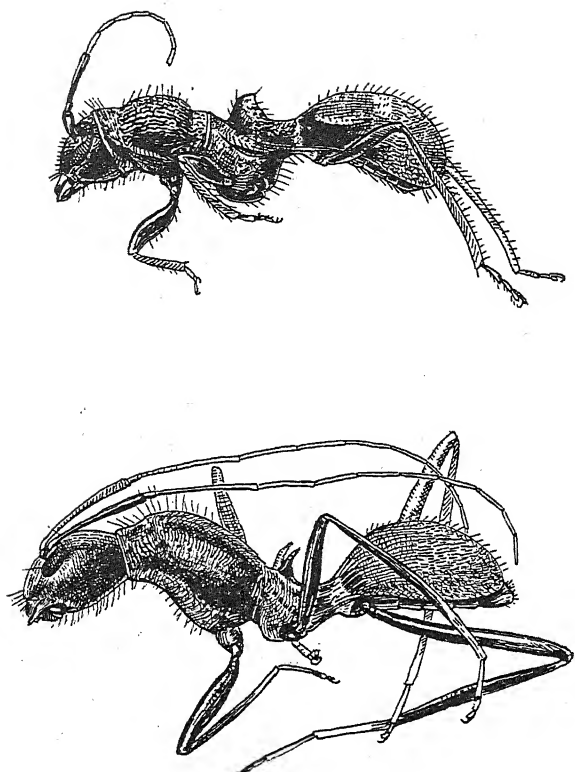


Fig. 15. Cerambycid beetles; the upper one superficially resembles a ponerid ant of the tribe Ectatommini, while the lower one suggests a camponotid ant. Length of upper figure, 5.5 mm.; of lower, 7 mm. New Caledonia.

It is the only species of the primitive genus *Myrmecia* that has been found outside Australia, including Tasmania.

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Two species of small, oddly-shaped cerambycid beetles (text fig. 15) were taken on shrubs in the Thi River forest. Both have a pair of thorns on the waist-like base of the elytra that fit so snugly over the abdomen. They are very ant-like; the larger beetle resembles ants of the tribe Camponotini, of which there are plenty in New Caledonia, the second more thickset and smaller has stouter elytral thorns and a coarse sculpture suggesting one of the ponerine

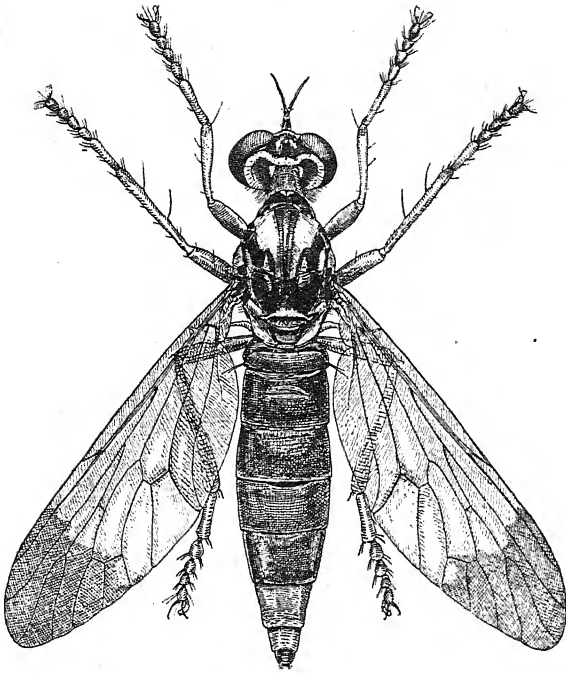


Fig. 16. A handsome asilid fly (*Neosaropogon* [?]) with orange and black wings and the abdomen tipped with red. It suggests a pompilid wasp. Length 14.5 mm. St. Louis, New Caledonia.

ants of the tribe Ectatommini, also well represented. Such resemblances between longicorn beetles and ants have been noted in Australia, and probably elsewhere (see Tillyard: 234, 1926).

Text figure 16 is a strikingly colored asilid fly near to, or of the genus *Neosaropogon*. The thorax is marked with fine yellow pile, the wings orange and black, the legs mostly orange-yellow while the abdomen is black marked with orange. Superficially it much resembles the orange and black winged pompilid wasps that inhabit the same situation. One of these flies was taken with a *Pison* wasp in its grasp.

*Neosaropogon* belongs to the subfamily Dasypogoninae, of which Tillyard says (362-363, 1926): "A group of wasp-mimicking forms belonging to this subfamily occur in Australia; they belong to the genera *Cabasa*, *Codula*, *Chrysopogon* and *Neosaropogon*."

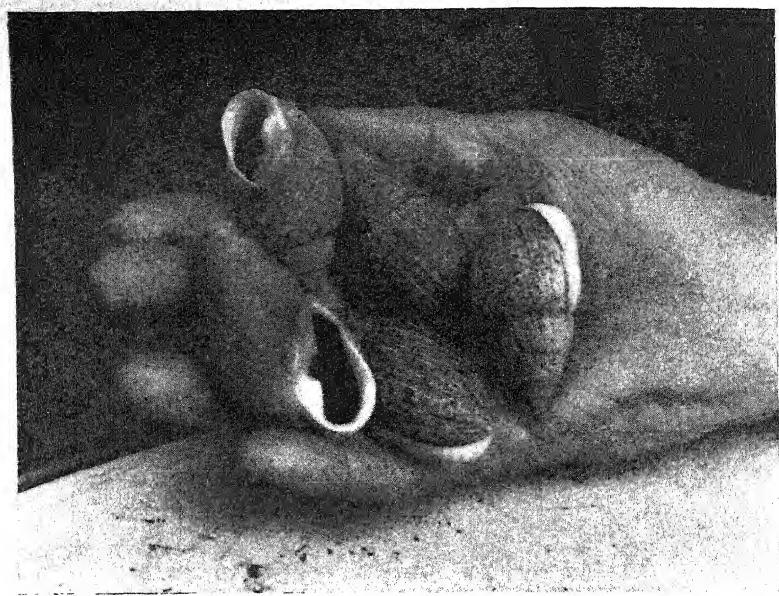


Fig. 17. Endemic land snails of the genus *Placostylus* from the hills behind Noumea. Other species of *Placostylus* may attain a length of five inches. They are considered a table delicacy.



Fig. 18. A giant gecko lizard (*Rhacodactylus leachianus* [Cuv.]) found only in New Caledonia, where it lives on the trunks of trees and in fissures in boulders. It often exceeds a foot in length. Its leathery egg shells may sometimes be found on the floor of the forest.

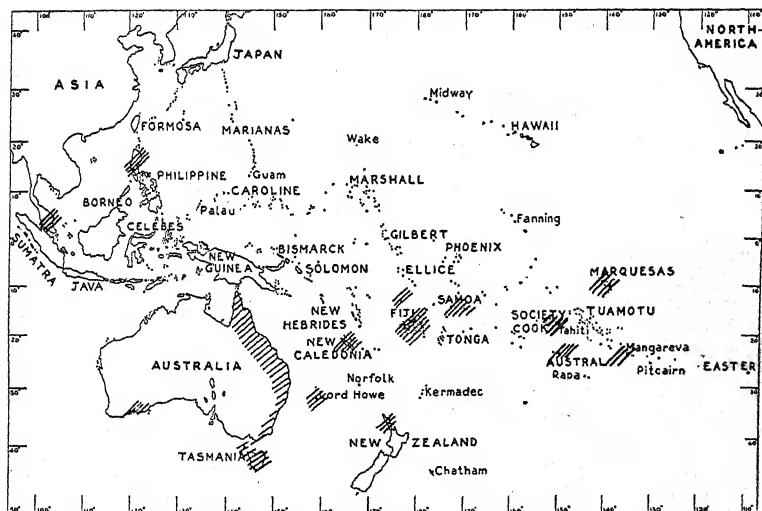
**New Ampagia Weevils From New Caledonia  
and the Philippines**  
(Coleoptera, Curculionidae)

By **ELWOOD C. ZIMMERMAN**

Bernice P. Bishop Museum, Honolulu

(Presented at the meeting of October 9, 1944)

THE cryptorhynchine weevil genus *Ampagia* Pascoe, 1870, has heretofore not been recorded from the Philippine Islands, and the description of a new species from that archipelago fills a gap in our knowledge of the distribution of the group. With the three new species described in this paper, there are now 48 described species in the genus. The appended map shows the distribution of the genus as it is now known.



Map showing the known distribution of the weevil genus *Ampagia*.

***Ampagia luzonae*, new species (figs. 5, 6)**

Male. Derm piceous to black, alutaceous to coarsely reticulate below, comparatively shiny above; antennae, tarsi and most of the first abdominal ventrite reddish brown; dorsum densely clothed with large, rounded, flat, thin, closely

appressed, imbricated squamae which normally completely conceal the derm; background scaling brown or brownish fawn colored with a slight iridescent cast, with the following color pattern: head and rostrum brown with a small, obscure area of darker scaling at top of crown which may perhaps not always be present; pronotum concolorous with the elytra but with a white median vitta; elytra with an elongate, common fascicle of nearly black, closely packed, erect or suberect setae or modified scales extending from the scutellum back to a distance equal to one-half the length of the pronotum on the first two intervals, this followed at a distance almost equal to its length by a small, irregular, probably variable patch of dark colored squamae, and with an oblique fascia beginning on interval two just before this last-mentioned dark patch and extending toward the humeri over intervals two to four inclusive, but perhaps variable in its length, elsewhere almost concolorous brown but with some rather obscure patches of dark and pale scales laterad and caudad; scaling on the legs predominantly brown; scaling below white.

*Head* with the interocular area flattened, with a row of large, erect, stout, spatulate setae along the inner margins of the eyes; crown without setae.

*Rostrum* with numerous erect setae, similar to those along the inner margins of the eyes, between and behind the antennae; the squamae dwindling away rapidly beyond the antennae; densely set with small, but rather coarse punctures beyond the antennae; with a fine, rather vague median carina extending from near the interocular area to beyond the antennae.

*Antennae* with the scape as long as the first two funicular segments, bearing a few fine setae; first funicular segment about as long as two plus three, two about as long as three plus four, four slightly transverse, the following segments each slightly broader; club as long as or slightly longer than funicular segments three to seven inclusive.

*Prothorax* (measured from directly above) slightly broader than long (49:43), broadest at extreme base; base only slightly sinuous; sides almost straightly narrowed from base to the broadly rounded apex which is about three-fifths as broad as the base; longitudinal dorsal contour evenly arcuate, not continuous with that of the elytra; punctures small, distinct, separated by about their own diameters on the disk, not evident unless the scaling is removed; squamae above the fore coxae about as broad as the breadth of the second antennal segment; dorsum with very conspicuous, large, erect, peg-like, subspatulate or clavate setae scattered from near base to apex.

*Elytra* not quite three-fourths as broad as long, broadest at a distance about equal to the breadth of the first three intervals behind the base, twice as long as the pronotum when measured from the side from the scutellum to the apex, its lateral outlines not continuous with those of the prothorax; the first two intervals slightly elevated at the base for a distance equal to about one-half the length of the pronotum to bear the common, ovate fascicle; striae narrow, showing faintly through the scaling, stria ten reaching to near the apex; stria punctures small or moderate in size, even on the sides, evidently not bearing distinct setae; the intervals bearing conspicuous, stout, erect, straight setae similar to those on the pronotum, most numerous on the odd-numbered intervals.

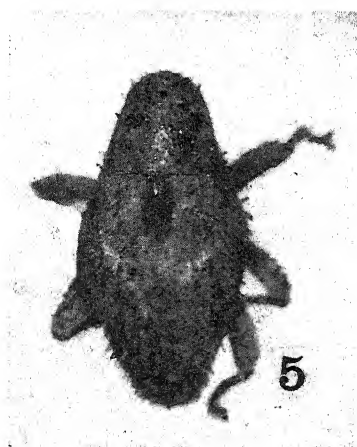
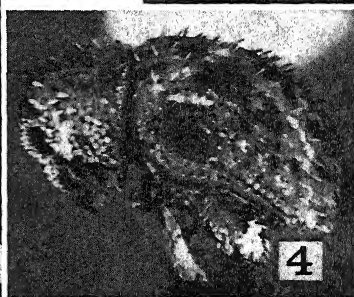
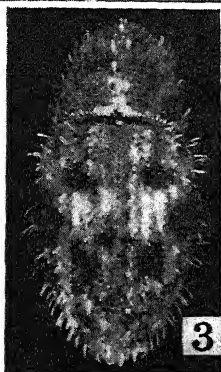
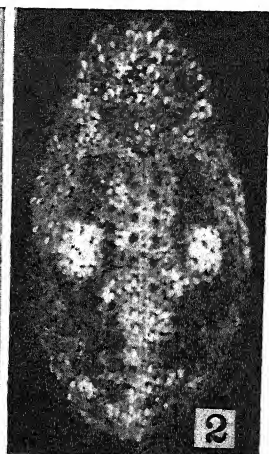
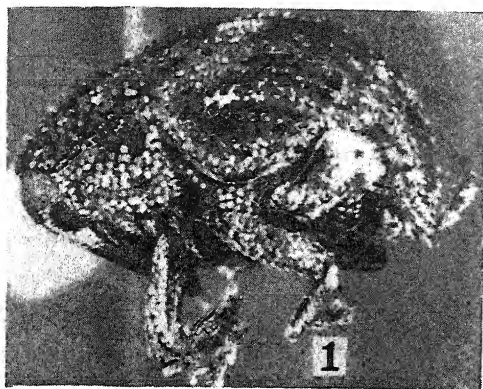
*Legs* with the dorsal angle of the hind femora about 115 degrees, its great-

#### LEGEND FOR FIGURES

Figs. 1 and 2, Dorsal and lateral views of *Ampagia williamsorum*, new species.

Figs. 3 and 4, Dorsal and lateral views of *Ampagia setiger*, new species.

Figs. 5 and 6, Dorsal and lateral views of *Ampagia luzonae*, new species. (Photographs 1-4 by W. Twigg-Smith of the Hawaiian Sugar Planters' Experiment Station, and 5 and 6 made at the U. S. National Museum, and reproduced by courtesy of L. L. Buchanan.)



est breadth divided into its greatest length equals about 1.8; squamae and setae mostly oval.

*Sternum* with the ventral margin of the mesosternal receptacle broad, squamose on the sides, setose at the middle, the posterior vertical median line carinate; metasternum reticulate, broadly concave, the anterior margin elevated, the intercoxal areas mostly clothed with large ovate and broadly lanceolate squamae, pleural areas with the scales smaller than those above the coxae on the pronotum.

*Abdomen* with the first ventrite about as long as the remainder of the abdomen along the median line, flattened but not distinctly concave in the middle in the male, its anterior median process distinctly inverted-V-shaped; the median plate marked off by distinct, well-impressed, coarse, straight lines, alutaceous and punctate, the punctures bearing prostrate setae which are elongate-oval and subsquamiform basad but become hair-like behind; ventrite two with large, oval or round appressed squamae; ventrites three and four each with a single, complete row of large oval scales; ventrite five twice as broad as long, with similar large scales but with hair-like setae caudad.

Length: 3.0 mm.; breadth: 1.5 mm.

Philippine Islands. Holotype male (United States National Museum no. 57245) collected by McGregor at Irisan, Benguet Province, Luzon, and without additional information.

This is an ordinary-looking member of the genus, but distinct from any of the previously described species. The low, dark, basal median fascicle on the elytra is distinctive.

#### THE NEW CALEDONIAN SPECIES

There have been heretofore three species of *Ampagia* recorded from New Caledonia; they were described by Lea (Trans. Ent. Soc. London, 77: 192-194, 1929). All of these were found in the vicinity of Noumea, but I have not seen them. However, from their descriptions it appears that each is quite distinct from the two species now before me.

#### KEY TO THE SPECIES

1. First elytral interval at least in part glabrous..... 2  
     First elytral interval entirely and densely clothed with  
     scales ..... 3
- 2(1). Setae of dorsum long, erect, bristling; first elytral interval glabrous, polished; scutellum minute.....  
     .....*cribricollis* Lea.  
     Setae of dorsum comparatively short, curved, more decumbent than erect; first elytral interval only partly glabrous; scutellum, comparatively large for the genus, truncate in front.....*seticurva* Lea.
- 3(1). Metasternum with a distinct granule between the mesocoxae and the elytra.....*granulifera* Lea.  
     Metasternum without such a granule on each side..... 4

- 4(3). Dorsal setae distinctly erect, bristling, comparatively long and slender (fig. 3).....**setiger** Zimmerman.  
 Dorsal setae stout, comparatively short, curved, more decumbent than erect (fig. 1)..**williamsorum** Zimmerman.

**Ampagia williamsorum**, new species (figs. 1, 2)

Derm piceous to black, antennae, tarsi and first ventrite more reddish brown, alutaceous to rather coarsely reticulate beneath, shiny above, when exposed; dorsum densely clothed with medium-sized, closely packed or imbricated, rounded, somewhat convex, finely striated squamae that conceal the derm; background scaling brown or brownish fawn-colored with slight iridescent reflections, and with the following color pattern: scales and setae at the base of the rostrum and the line of suberect setae along the inner margin of each eye white, squamae of the interocular area darker brown than the somewhat golden brown of the crown; pronotum with a small patch of a few (about three to six) white scales behind the middle before elytral interval four and with some scattered white setae, a dark apical area at each side of the median line, a large, dark, rather obscurely marked vitta on either side of the median line from the base to the middle or slightly beyond and a dark band on the sides before elytral intervals six or seven, excepting for the erect white setae, most of the other erect setae are black; elytra with most of the erect setae in the intervals black, some brown, and some white, with a basal black blotch on interval three encroaching onto intervals two and four followed by a conspicuous white patch centered on stria three and extending over striae two and four, then an extensive, irregular, variable area of black scales extending from interval two obliquely forward to the sides near the humeral area but not encroaching on the first interval and its most anterior extension not clearly defined from directly above owing to the convexity of the elytra; scaling on the legs mostly pale and dark brown, hind femora largely white at base and apex with a distinctly contrasting brown transverse band which extends to the lower apex; scaling below white.

*Head* with the interocular area flattened, with a row of large, broad, spatulate, white, fluted setae along the inner edge of each eye and a few such setae extending from the base of the rostrum onto the disk; crown with no distinct setae except for some dark ones adjacent to the interocular area.

*Rostrum* with mostly large, erect or suberect squamae and squamiform setae together with a few slender ones at the base; alutaceous and reticulate, densely punctate to the apex, less coarsely so in the female than in the male.

*Antennae* with the scape as long or slightly longer than the first two funicular segments combined; funicular segment one about as long as two plus three, segment two about as long as three plus four, the succeeding segments each more transverse, seven about twice as broad as long; club as long as the preceding four funicular segments.

*Prothorax* (measured from directly above) transverse, but not appearing obviously so (20:25 and 19:23 in the types), broadest at the extreme base; base only slightly sinuous, sides nearly straight, only slightly arcuate to the broadly rounded apex which is more than three-fifths as broad as the base; longitudinal dorsal contour almost evenly and rather strongly convex, slightly, but obviously discontinuous in outline with the elytra; punctures medium-sized, dense, those on the disk closer together than their diameters, not obvious unless the scales are removed; the larger squamae above the fore coxae each about as broad as the second funicular segment; dorsum with numerous, conspicuous, curved, spatulate, anteriorly inclined setae from base to apex.

*Elytra* ovate, about three-fourths as broad as long, broadest slightly behind the base, slightly more than twice as long as the pronotum when measured on the side from the scutellum to the apex, the lateral outlines only slightly discontinuous with those of the prothorax; the first two intervals hardly per-



ceptibly elevated basad; striae narrow, faintly showing through the scaling, the punctures small, excepting those basad on the sides, and bearing small, prostrate, usually white setae, stria ten extending to near the apex; the intervals bearing distinct, spatulate setae which are not erect but curved and inclined backward.

*Legs* with the dorsal angle of the hind femora approaching a right angle, its greatest breadth divided into its greatest length equals about 1.7, squamae and setae large, broadly oval.

*Sternum* with the ventral margin of the mesosternal receptacle moderately broad, squamose and setose, the posterior vertical median line narrowly carinate; metasternum strongly concave in both sexes, coarsely reticulate, anterior margin strongly elevated, punctate, setose and squamose between the coxae; the squamae on the pleura only slightly smaller than those on the pronotum above the fore coxae.

*Abdomen* with the first ventrite approximately as long as the remainder of the abdomen along the median line, concave in both sexes, coarsely reticulate, punctures coarsest basad, bearing broad squamae basad which become more slender caudad and mesad to give way to hair-like setae, the anterior median border broadly and very flatly inverted-V-shaped, nearly subtruncate, the median plate bounded by a well-impressed slightly curved line, with oval or round scales on the sides behind the line; ventrite two with large oval or round squamae borne from punctures which are most numerous on the sides but extend entirely across the ventrite; ventrites three and four with one to a few setae at the sides only; ventrite five about twice as broad as long in the female, not quite twice as broad as long in the male, punctate, densely clothed with large rounded squamae which give way to some erect, fine hairs at the middle behind.

Length: 2.75-3.0 mm.; breadth: 1.4-1.5 mm.

New Caledonia. Holotype male, beaten from branches of *Acacia laurifolia* Willd. at Noumea, August 26, 1940, and allotype female beaten from the same host in the hills behind Noumea, August 16, 1940. Both specimens were collected by F. X. Williams and are stored in the type collection of Bishop Museum.

On this broadly oval species, which may be distinguished from its New Caledonian associates by the characters summarized in the key, the two patches of white scales on the elytra appear to the unaided eyes as two rounded dots which interrupt the black scaling on either side of the sutural intervals which (the intervals, that is) appear as a brown stripe.

It gives me pleasure to dedicate this species to my friends Dr. and Mrs. Francis X. Williams who together made an entomological reconnaissance survey of New Caledonia in 1940.

### ***Ampagia setiger*, new species (figs. 3, 4)**

*Male*. Derm reddish brown to piceous, ventral surfaces alutaceous or finely reticulate, shiny above, when exposed; dorsum densely clothed with closely packed squamae which conceal the derm, the squamae appearing microscopically granulate so as to produce an iridescence and not or indistinctly striated, those on the first interval smaller and denser basad than on the other intervals where they are similar in size and shape to those on the pronotum; background scaling pale brown and fawn, and with the following color pattern: scales and setae on the rostrum and interocular area yellowish white, crown bronzy brown; prothorax with some white scales on the sides, and the pronotum

tum with a few white scales before the scutellum and a small patch of two or three scales (probably variable) behind the middle and before elytral intervals five or six, and with a black basal area before elytral intervals two to six which may be vaguely sub-inverted-V-shaped; elytra with a small black patch centering on interval three and extending onto intervals two and four just before the basal third, this followed by a scattering of white squamae, and with an irregular, variable area of black patches extending from or near the suture at about the caudal third obliquely forward and expanding toward the outer fore corner of each elytron, setae mixed brown, black and white, the squamae in the striae punctures white and distinct; scaling on the legs white and pale brown, the hind femora with an oblique band of pale brown from the dorsal edge to lower apex with pale scales on each side; scaling below white.

*Head* with the interocular area flattened, with large concave scales continued from the base of the rostrum, with one or two rows of large, erect, spatulate setae on either side and across the lower part of the crown which otherwise is mostly free of setae.

*Rostrum* in the male closely set with large squamae to beyond the antennae and with numerous smaller squamae, setiform squamae and setae from there to the apex, with numerous large, erect setae from the base to beyond the antennae; closely punctate.

*Antennae* with the scape about as long as the first three funicular segments combined, about as broad at apex as the length of the second funicular segment; first funicular segment nearly as long as the following three segments together, second funicular segment slender, about as long as three plus four, the following segments each slightly broader, the seventh less than twice as broad as long; club as long as the preceding five funicular segments.

*Prothorax* (measured from directly above) transverse, but not appearing so (33:28, holotype, 37:32, paratype), broadest at the extreme base, thence nearly straightly narrowed to the rounded apex which is about five-sevenths as broad as the slightly sinuous base; longitudinal dorsal contour evenly convex, obviously discontinuous with the dorsal elytral outline; punctures small at the base but becoming large and more elongate-oval cephalad, mostly closer together than their diameters, not obvious unless the scales are removed; the larger squamae above the fore coxae each about as broad as the first funicular segment; dorsum with numerous, large, nearly straight, erect, spatulate setae.

*Elytra* ovate, broadest just behind the humeri, about two-thirds as broad as long and a little more than twice as long as the pronotum when measured from the side from the scutellum to apex, the lateral outlines slightly discontinuous with those of the prothorax; the first intervals each slightly elevated basad; striae narrow, their punctures small and well-isolated on the disk, bearing distinct, prostrate, elongate-oval squamae, the outer stria terminating above the hind margin of the metacoxae and with coarse, close punctures from there to the base; the intervals each bearing a row of long, erect, slightly curved spatulate setae.

*Legs* with the dorsal angle of the hind femora nearly a right angle, its greatest breadth divided into its greatest length equals about 1.5; squamae and setae large on all femora, the setae slanting, similar to those on the dorsum.

*Sternum* with the ventral margin of the mesosternal receptacle moderately broad, squamose, the posterior median vertical line cariniform; metasternum strongly concave, finely reticulate, anterior margin elevated between the coxae, not distinctly punctate, setose and squamose only between the coxae; the squamae on the pleura mostly distinctly smaller than those on the sides of the pronotum.

*Abdomen* with the first ventrite slightly shorter than the remainder of the

abdomen along the median line, disk broadly concave, alutaceous or finely reticulate, finely punctate, the punctures bearing prostrate, fine setae or slender, squamiform setae, without large coarse punctures, the anterior border flatly sub-inverted-V-shaped, the bounding line deep, slightly curved, nearly straight with only a few slender scales at the sides behind the line, posterior subvertical margin of the ventrite with a line of rounded squamae; ventrite two with medium-sized, oval squamae borne from punctures; ventrites three and four each with a row of small, rounded squamae normally continued entirely across the ventrites; ventrite five not quite twice as broad as long, closely punctate, densely clothed with comparatively small to medium-sized oval squamae which give way to fine, curved, suberect setae in about the apical half.

Length: 2.1-2.4 mm.; breadth: 1.0-1.2 mm.

New Caledonia. Holotype male collected at Hienghene, October 5, 1940 by F. X. Williams, and one male paratype bearing the labels "Noumea N. Caledonie Delauney" and the name label "*Ocladius narius* (or *nasius* ?) Fauv. Collection Fleutiaux". The types are stored in Bishop Museum.

The name *Ocladius narius* Fauvel, is evidently a manuscript name, for I can find no record of any such species having been recorded. *Ocladius* does not occur in the Pacific.

The bristling erect setae serve to separate easily this species from *williamsorum*, and the completely squamose elytral intervals and the absence of a granule on the metasternum distinguish it from the other New Caledonian *Ampagia*.

## New Insect Records for the Year 1944

BY THE EDITOR

Species marked with an asterisk were observed in the Hawaiian Islands for the first time in 1944, on the date mentioned in the text. Those not so marked were observed here prior to that year, but have only now been identified. For details of the records refer to the pages indicated.

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PROCEEDINGS  
OF THE  
Hawaiian Entomological Society

Editor Emeritus, O. H. Swezey

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VOL. XII, No. 3

FOR THE YEAR 1945

MAY, 1946

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JANUARY 8, 1945

The 469th meeting was held at the H.S.P.A. Experiment Station on Monday, January 8, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Fullaway, Jensen, Nishida, Pemberton, Rosa, Sakimura, Schmidt, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Messrs. C. T. Parsons and F. G. Werner.

NOTES AND EXHIBITIONS

*Psoroptes communis* Fürstenberg—Mr. Pemberton reported the presence of quantities of this scab mite in the ears of a rabbit. The mites were collected by a member of the U. S. Army on Oahu, December 26, 1944. This is the first record of this sarcoptid in the Territory.

*An aphid new to Hawaii*—Mr. Van Zwaluwenburg called attention to the description by E. O. Essig of *Cerosipha californica* n.sp.<sup>1</sup> (Hilgardia, 16 [4]: 177-181, fig. 1, July 1944) from California and Oahu. It was first found at Salinas, Calif., on roots of slightly wilted seedlings of guayule (*Parthenium argentatum* Gray). Later it was found on roots of potatoes at Bakersfield, and (alates) on leaves of French prune at Davis, Calif. In checking alate specimens of what he provisionally considered to be *Vesiculaphis caricis* (Fullaway), collected September 9, 1940, on tomato by W. C. Look at the "Waipaha" [Waipahu] school garden, Prof. Essig found them to be this "guayule aphid".

*Achaea janata* (Linn.)—Mr. Sakimura reported finding three specimens of this agrotid moth at light immediately after the Society's last meeting in December at which the species was first re-

<sup>1</sup> This insect was later shown by Prof. Essig to be a synonym of *Cerosipha subterranea* (Mason), a species widely distributed in the continental United States from Maryland to California. See p. 468 [Ed.].

corded locally. That the moth has suddenly become fairly numerous was attested by reports of several other members who have collected it recently.

*Hambletonia pseudococcina* Compere—Dr. Schmidt reported the recovery of this encyrtid parasite of *Pseudococcus brevipes* (Cockerell) from material collected recently at Baldwin Packers, west Maui; it had not previously been reported from this region. The parasite was imported from South America during the period from 1935 to 1937.

## FEBRUARY 12, 1945

The 470th meeting was held at the H.S.P.A. Experiment Station on Monday, February 12, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Faxon, Fullaway, Jensen, Keck, Marlowe, Murakami, Pemberton, Rosa, Swezey, Van Zwallowen, Williams and Zimmerman.

*Visitors:* Messrs. A. S. Johnson, J. D. Maple and E. M. Miller.

Mr. Fullaway nominated Mr. Douglas J. Worcester for membership in the Society.

## NOTES AND EXHIBITIONS

*Leptomastix dactylopii* Howard—Mr. Fullaway exhibited specimens of this aphelinid parasite of mealybugs recently found established at the Territorial plant nursery in Honolulu, a new record for the Islands. This is an accidental introduction from California, and Mr. Fullaway's specimens came from a mixed infestation on soybeans and eggplant of *Phenacoccus gossypii* Townsend & Cockerell and *Pseudococcus kraunhiae* (Kuwana).

*Backyard insect census*—Dr. Swezey reported progress on the insect census of his garden and residence on Lanihuli Drive, Manoa Valley, Honolulu. Since his last report (Proc. Haw. Ent. Soc., 11: 277, 1943) he has added about 40 names, so that now the total is 293, distributed in the following orders: Hymenoptera 57; Diptera 41, Coleoptera 63; Lepidoptera 43, Heteroptera 11; Homoptera 28; Orthoptera 10; Dermaptera 2; Blattaria 9; miscellaneous 29.

*Achaea janata* (Linn.)—Dr. Swezey reported that R. E. Doty had brought him a specimen of this immigrant agrotid collected at light on Mt. Tantalus, February 5. Dr. Swezey also reported the capture of two of these moths at light on February 11 at his house in Manoa Valley.

*Identity of the new immigrant parasite of cockroach eggs*—Mr. Zimmerman reported that Dr. Harold Compere had identified the new encyrtid parasite of cockroach oöthecae as *Comperia falsicornis*

(Gomes). The species was described from the Federal District of Brazil, as *Comperia merceti* var. *falsicornis* Gomes (Bol. Escola Nac. Agro., 2: 30-37, 1942). Mr. Zimmerman previously reported upon the successful work of this parasite on oöthecae of *Supella supellectilium* (Serville) at a meeting of the Society in 1943 (Proc. Haw. Ent. Soc., 12: 20, 1944). It is the same species as that recorded by Mr. Pemberton (Proc. Haw. Ent. Soc., 11: 139, 248, 1942) as probably *Metaphycus* sp.

*Caenis* sp.—Dr. Jensen exhibited a mayfly he had collected in Gilmore Hall, University of Hawaii, Manoa, Honolulu, on the night of January 30, 1945. The specimen apparently had been attracted to the light and entered the room through an open window. This record represents an extension in distribution of this order from Pearl City to Manoa Valley. Other specimens of this ephemerid were first collected in Hawaii in July 1944, in a light trap operated by Lt. Wm. M. Herms, U.S.N.R., at Pearl City, Oahu. According to Dr. Swezey, who identified the Pearl City material, the genus *Caenis* Stephens is cosmopolitan; the adults of the family Caenidae, to which it belongs, are characterized by having very few cross veins and no hind wings.

*Blapstinus dilatatus* LeConte—Dr. Jensen exhibited specimens of this tenebrionid beetle collected at Koko Head, Oahu, September 20, 1944. Adults were reported injuring watermelon plants, chewing the vines two or three feet from the base of the plant, thus causing the vines to wilt. The species is common in southern California where it has been recorded girdling young pepper plants. Three specimens were collected earlier by Messrs. Look and Nishida in soil at Waialua, Oahu, June 16, 1944. The specimens were determined by Dr. E. C. Van Dyke; earlier local identifications of this species had been only tentative.

A gynandromorph *Contarinia*—Dr. Jensen exhibited a slide mount of an unusual gynandromorph which occurred among adults of a cecidomyiid, *Contarinia* sp., reared from flower buds of "pikake" (*Jasminum sambac*). A single specimen was found which bears female antennae, but male genitalia. The characters of the antennae of the sexes are as conspicuously different as are the genitalic characters. The pikake buds were collected by Dr. Jensen near Fort Ruger, Honolulu, January 11, 1945. Approximately 75 per cent of the living buds were infested with eggs, larvae or both.

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### MARCH 12, 1945

The 471st meeting was held at the H.S.P.A. Experiment Station on Monday, March 12, at 2:00 p.m., with President Jensen in the chair.



*Members present:* Messrs. Bianchi, Fullaway, Jensen, Nishida, Pemberton, Rosa, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Messrs. O. H. Edinger, Wm. D. Field, J. E. Webb, Jr., and F. N. Young.

Mr. Douglas J. Worcester was unanimously elected to membership.

#### NOTES AND EXHIBITIONS

*Tribolium castaneum* (Herbst)—Mr. Van Zwaluwenburg called attention to a paper by Newell E. Good (U.S.D.A. Tech. Bul. 498, "The Flour Beetles of the Genus *Tribolium*", 1936) in which it is shown that the red flour beetle, a cosmopolitan pest, should be known as *Tribolium castaneum* (Herbst), and not as *T. ferrugineum* (Fabr.). Two species were described by Fabricius under the name *Tenebrio ferrugineus*. The first one so named, in 1781, is a cucujid, on the authority of Waterhouse and others; the same name used in Fabricius' 1787 description, is a homonym, and cannot stand.

*Hyposoter* bred from *Achaea*—Mr. Van Zwaluwenburg reported that one of three larvae of the recently established agrotid, *Achaea janata* (Linn.), collected March 8 at Waialua mill, Oahu, on the weed known locally as *Euphorbia bifida* Hooker & Arnott, yielded a cocoon of the ichneumonid, *Hyposoter exiguae* (Viereck), two or three days later. Earlier the same week, Mr. Rosa observed an adult *Hyposoter* in a jar containing *Achaea* larvae collected at Waianae, Oahu.

*New geometrid moth*—Mr. Pemberton discussed the status of an unidentified geometrid<sup>2</sup> recently found widely distributed over Oahu. Over a dozen moths were first caught in a light trap operated by the Navy at West Loch, Pearl Harbor, during August 1944. Then, early in February 1945, Dr. Williams found some strange caterpillars feeding on foliage of *Nicotiana glauca* in his garden in Honolulu. Reared to adults, they proved to be the same as the moths caught at Pearl Harbor. Examination by Dr. Swezey showed the species to be new to Hawaii. Field surveys by H.S.P.A. entomologists resulted in the recovery of the moth during February over most of this island, and on Mt. Tantalus to an elevation of 1,600 feet. Larvae were found feeding on the leaves of 29 different plants, and in some cases causing considerable defoliation. Many of the host plants are ornamental flowering trees, and several are important forage trees and shrubs. The list embraces 14 different plant families, with Leguminosae especially favored. It is assumed that the insect came to Oahu in an airplane.

<sup>2</sup> Subsequently identified as *Anacamptodes fragilaria* (Grossbeck), an insect native to southern California [Ed.].

✓ *Achaea janata* (Linn.)—Mr. Pemberton also discussed the result of surveys made to determine the present distribution and host plants of this large agrotid, first seen in Hawaii in December 1944, when Dr. Williams collected an adult at the H.S.P.A. Experiment Station, Honolulu. Caterpillars were found in quantity at Waianae and Ewa, Oahu, feeding on, and completely defoliating, castor oil plant (*Ricinus communis* Linn.). It was also found on the common weed, *Euphorbia bifida* Hooker & Arnott and on the forage plants *Leucaena glauca* Benthann and *Desmanthus virgatus* Willdenow; a single larva was taken on a partially eaten leaf of a fern (*Polypodium* sp.).

Because this moth is widespread from India through the Malay Archipelago to New Guinea, Australia and many of the South Pacific islands, and has been found in airplanes arriving at Honolulu, it is assumed to have reached Oahu by plane. Mr. Bianchi stated that he had found the eggs of *Achaea*, chiefly on leaves of *Ricinus* and *Euphorbia*, widespread over Oahu. The eggs are laid singly, and all that he had collected yielded adults of *Trichogramma minutum* Riley.

*Enarmonia walsinghami* (Butler)—Dr. Swezey reported having reared several of this tortricid moth from dead, malformed, small branches of *Acacia koa* sent in by C. J. Davis, a ranger at the Hawaii National Park, Hawaii. The material was collected at an elevation of 6,700 feet on the Mauna Loa trail, February 2, 1945. This is the same moth Dr. Swezey previously reared from dead koa twigs on Mt. Tantalus and Mt. Olympus on Oahu, and from koa rust galls on Maui. Mr. Davis found the larvae boring in the living wood where the twig or branch was malformed from the effects of rust galls or something similar. Thus, it is shown that it does not confine itself to dead wood as a diet, as many Hawaiian moths are known to do. This is similar to Mr. Davis' observations of *Neoterмес connexus* Snyder feeding in living koa branches, a sample of which he sent in early this year. It was collected in the Kipuka Puaula at the Hawaii National Park, and showed considerable excavation by termites in the heart wood of a branch three to four inches in diameter, which was still alive. Usually this termite feeds in dead branches and trunks of the native forest trees.

*Podagrion mantis* Ashmead—Dr. Swezey reported that in determining for Mr. Sakimura insects caught in wind traps in the pineapple fields of the Kunia, Oahu, region, he found specimens of this callimomid parasite of mantis eggs, dated April 27, 1943, May 4, 1943, July 13, 1943 and August 17, 1943. The first two dates are prior to the first record reported from Molokai by Mr. Krauss, May 31, 1943 (Proc. Haw. Ent. Soc., 12: 92, 1944).

*Phygadeuon* sp.—Dr. Swezey reported this ichneumonid parasite of syrphids was also found in Mr. Sakimura's material, collected

February 8, 1944. It is apparently its first record from Oahu. It was first collected in July 1932, at the Hilo Sugar Co., Hawaii, by Dr. Williams (Proc. Haw. Ent. Soc., 8: 233, 1933).

*Solierella rohweri* (Bridwell)—Dr. Williams exhibited a female of this larrid wasp caught by Mr. Sakimura in a wind trap at Kunia, Oahu, August 8, 1944. The head of this insect was quite abnormal, since there were no ocelli and the eyes converged very strongly at the vertex instead of having their inner margins nearly parallel.

*Cerosipha subterranea* (Mason)<sup>3</sup>—Mr. Zimmerman reported that Mr. Essig had informed him that the aphid recently found on Oahu, and described as the "guayule aphid," *Cerosipha californica* Essig (Hilgardia, 16 [4]: 177, fig. 1, 1944) has been found to have been described previously by Mason (Proc. Ent. Soc. Washington, 39 [6]: 166, fig. 1, 1937) as *Rhopalosiphum subterraneum*, and that the new name combination *Cerosipha subterranea* (Mason) should be applied to the species.

*Ilburnia ipomoeicola* (Kirkaldy)—For Mr. Look, Mr. Fullaway reported the finding of this delphacid, the sweet potato leafhopper, near Kilauea, Hawaii. Eggs of this insect were also found in the stems of the vines.

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#### APRIL 9, 1945

The 472nd meeting was held at the H.S.P.A. Experiment Station on Monday, April 9, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Carter, Faxon, Fullaway, Hadden, Holdaway, Jensen, Nishida, Pemberton, Sakimura, Swezey, Tanada, Van Zwaluwenburg, Williams and Zimmerman.

*Visitor:* Mr. W. W. Wirth.

Mr. Fullaway and Dr. Williams presented the following resolution:

Lehr Artiman Whitney

*Whereas*, in the death of Lehr Artiman Whitney on February 21, 1945, the Hawaiian Entomological Society has lost one of its oldest and most cherished members, therefore

*Be it resolved* that the Society record its great and grievous loss with due expression of its appreciation of the interest of its distinguished member in the affairs of the Society which he served as Vice-President in 1929, and as President in 1930, and in the Proceedings, to which he made many valuable contributions in the way of papers, notes, etc., embodying his observations and recording other scientific data.

<sup>3</sup> See p. 463.

With the adoption of the above resolution the Secretary is requested to send a copy of the same to the surviving brothers of the deceased with a note expressing the deep sympathy of the members of the Society in their bereavement.

#### NOTES AND EXHIBITIONS

*Beetles in mango twigs*—Mr. Fullaway exhibited a collection of beetles found feeding in living twigs of mango on Kauai by Stephen Au; they were determined by Dr. Swezey as follows: (?) *Lyctus brunneus* (Stephens), 2; *Xyleborus* sp., 1; and several *Stephanoderes* sp.

*Parasites of Achaea janata* (Linn.)—Mr. Bianchi exhibited several puparia of *Eucelatoria armigera* (Coquillett) and some adults of *Chaetogaedia monticola* (Bigot) which had issued from pupae of *Achaea janata*. One *Chaetogaedia* had issued on April 4 from a pupa reared in the laboratory on *Ricinus* at Manoa Valley on February 14. The others had issued from material collected at Ewa during the first part of March. The *Eucelatoria* puparia had been found within skins of *Achaea* caterpillars collected on *Ricinus* plants growing along the Waianae road near Ewa on March 31.

*Stegania* sp.<sup>4</sup>—Mr. Bianchi stated, for Mr. Rosa and himself, that on March 19, at Waianae, Oahu, they had discovered egg masses of the new geometrid (*Stegania* sp.) under bark on the trunks of kiawe (*Prosopis chilensis*). Eggs had not been found in the field before, although the moth's manner of oviposition in the laboratory had indicated the probability that they would be found eventually under bark. Mr. Bianchi pointed out that in such a location the eggs would be almost completely protected from attack by *Trichogramma minutum* Riley, and said that out of many field-collected egg masses, totalling probably over 1,000 eggs, not a single parasite had issued, although in the laboratory *Trichogramma* had been shown by Dr. Swezey to parasitize the eggs readily.

*Ephialtes hawaiiensis* (Cameron)—Mr. Bianchi exhibited specimens of this ichneumonid which he and Mr. Rosa had reared in the laboratory on pupae of *Stegania* sp. Numerous *Ephialtes* wasps had been observed at Waianae on March 19 hovering over soil which thinly covered many pupae and prepupae of *Stegania*; from this behavior it was surmised that the wasps would parasitize the pupae. This proved to be the case in the laboratory, but it is apparently a rare occurrence in the field, for not one *Ephialtes* was obtained from about 150 *Stegania* pupae collected at Waianae. Mr. Bianchi stated that *Ephialtes* in glass tubes will readily sting the pupae, the prepupae, and even the larvae of *Stegania*, but that only a small proportion of the attacks results in successful oviposition. The wasps were also observed in the laboratory to attack the pupae

<sup>4</sup> This is the insect subsequently identified as *Anacamptodes fragilaria* (Grossbeck) [Ed.].

of *Achaea janata* (Linn.), but with as yet undetermined effectiveness. The wasps exhibited had emerged in about 16 days from the time of oviposition, a remarkably short time for a parasite of their size. *E. hawaiiensis*, according to data in the H.S.P.A. collection, has been reared previously from pupae of *Pyroderces incertulcella* (Walker), *Archips postvittanus* (Walker), *Euhypsozomoma ekaha* (Swezey), *Capua reynoldsiana* Swezey, *Capua cassia* Swezey and *Cryptophlebia* sp., all native microlepidoptera.

*Anaphothrips obscurus* (Müller)—Mr. Bianchi spoke of a mild infestation of this thrips on sudan grass grown for experimental purposes in the hothouse at the H.S.P.A. Experiment Station. The species was first found in the Territory in the same locality and under the same circumstances in January 1941, and had not been reported again until now.

*Notogramma stigma* (Fabr.)—On behalf of Mr. Ito, Dr. Carter presented the following: This ortalid fly was recently bred from a dead and rotting stem of *Dendrobium superbum* at Kapahulu, Honolulu. While the owner of the plant suspects that the maggots are casual, the infestation must undoubtedly have occurred after the death of the plant, for this fly has been previously reported breeding in decaying fruits and rotten sugar cane.

*Neophyllaphis araucariae* Takahashi—Dr. Swezey reported having collected this aphid from young *Araucaria* trees at Foster Gardens, Honolulu, March 31. Dr. H. L. Lyon had called his attention to this slight infestation on young trees in tubs at the nursery. A supply of specimens was collected to send to Prof. E. O. Essig, who desired material of this species. The yellow wingless aphid occurred among the closely approximated leaves at the tips of growing twigs, and would readily escape observation. Four winged forms were obtained. The infestation was discovered by the presence of larvae of the ladybird beetle *Cryptolacmus montrouzieri* Mulsant. These ladybirds, however, were present on account of the coccid *Eriococcus araucariae* Maskell, individuals of which were scattered among the leaves of the terminal twigs. Several of these white coccids were noticed to have exit holes where parasites had issued, and a female parasite was noted in a search among young coccids at the base of the leaves. No doubt this was *Aphycomorpha araucariae* Timberlake, an encyrtid described in Proc. Haw. Ent. Soc., 4: 227, 1919. This is the first time Dr. Swezey had observed these three insects: *Neophyllaphis*, *Eriococcus* and *Aphycomorpha*. On the same trees a puparium of the syrphid fly *Ischiodon scutellaris* (Fabr.) was found which had exit holes of the pteromalid parasite *Pachyneuron allograptae* Ashmead. The aphid-feeding ladybird, *Coelophora inaequalis* (Fabr.), was also present. Two lacewing-fly cocoons were also found, from which adults issued April 5 and proved to be *Chrysopa lanata* Banks.

*Trichogramma* reared from sphingid eggs—Dr. Swezey reported that 11 specimens of *Trichogramma minutum* Riley and one of *T. semifumatum* (Perkins) issued from a sphingid egg found by Dr. Williams on a leaf of *Nicotiana glauca* at his home on Keeaumoku Street, February 14. The egg was undoubtedly that of *Herse cingulata* (Fabr.), though this moth usually oviposits on leaves of several species of *Ipomoea*. Sweet potato vines were growing nearby.

*Trichophaga tapetzella* (Linn.)—Dr. Swezey reported on two additional records for this tineid moth in Hawaii: 2 specimens from wind trap in pineapple field, Kunia, Oahu, December 2 and 3, 1944 (Sakimura); 2 specimens from light trap, Hickam Field, Oahu, April 8, 1945.

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### MAY 14, 1945

The 473rd meeting was held at the H.S.P.A. Experiment Station on Monday, May 14, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Faxon, Hadden, Jensen, Keck, Look, McBride, Nishida, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams and Zimmerman.

*Visitors:* Messrs. G. F. Augustson, B. Krafchick, D. B. Langford, J. G. Lewis, F. A. Soraci, J. P. Vinzant and W. W. Wirth.

Dr. Williams nominated Mr. Willis W. Wirth for membership in the Society.

### NOTES AND EXHIBITIONS

*Draeculacephala* sp. a pest of watercress—Dr. Holdaway reported on an insect problem which has become serious in watercress beds since September 1944. The species has been tentatively determined as *Draeculacephala mollipes* (Say).\*

Observations were made on watercress beds in the vicinity of Pearl Harbor, March 19, 1945. Inquiries from several growers revealed the following state of affairs: The trouble is present all the year round, but is most serious in the summer months. In September 1944 it became so serious as to reduce production seriously. It has been difficult to secure an exact picture of the injury, since, at the time the observations were made, rotenone dust had been used freely on the watercress and the infestation had been materially reduced. There appear to be two types of injury, the first, a crinkling of the young leaves which reminds one of the injury caused by broad mite (*Hemitarsonemus*) on watercress, although no mites were found. The second type of injury, apparently associated with

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\* According to Dr. P. W. Oman there are two species of *Draeculacephala* in Hawaii. One, *D. minerva* Ball was first found on Oahu in 1912, and is a southwest United States species. The other, *D. mollipes* (Say) was first taken in Honolulu in 1934, and is a native of the northeastern United States. The above dates are supplied by Mr. E. C. Zimmerman from his unpublished "Insects of Hawaii". [Ed.].

the infestation, is a general yellowing of the older leaves with yellow blotches on the less mature leaves. While this type of injury is apparently associated with an infestation of *Draeculacephala*, since growers report that it ceases to increase when the leafhoppers are controlled by means of rotenone, the injury has the appearance of a disease.

Dr. Holdaway observed *Draeculacephala* in watercress beds at Waipahu in the early part of 1942 when engaged in observations on broad mite on watercress. It would appear that *Draeculacephala* is a common insect of watercress beds, but that not until September 1944 did abundance reach such a level as to be a cause of economic loss.

It is interesting to speculate on why the insect has increased so greatly as to reach economic importance. Two possibilities occur to Dr. Holdaway. First, that particular weather conditions have favored the leafhopper more during the past twelve months than formerly; second, that the increase in watercress production has favored an increase in abundance of the leafhopper. It is not possible, at present, to determine to what extent the first possibility may have operated. Records indicate, however, that production of watercress has increased. Before the war the crop enumerators of the University extension service did not secure records on production of watercress, and so, earlier records are not available. The records for 1943 give a production of 1,003,000 pounds, while in 1944 the production was 1,598,000 pounds—an increase of 50 per cent over the 1943 production which was higher than formerly.

At the time of the observations at Waipahu in 1942, the grower reported that addition of copper sulphate to the irrigation water for control of crayfish appeared to reduce abundance of the leafhopper. Such an observation, if correct, would be in line with observations on control of *Empoasca fabae* (Harris) on the mainland, and *E. solana* DeLong in Hawaii; both of these can be controlled by sprays of Bordeaux. In the case of *E. fabae*, DeLong has demonstrated that control follows absorption of copper by the plant. Inquiries at Pearl Harbor last May revealed that addition of copper sulphate to the extent of 10 to 15 pounds per time, to the head water for control of algae, did not control crayfish and apparently had had little effect on *Draeculacephala*.

*Infestation of celery aphid*—Dr. Holdaway referred to an infestation of celery aphid, *Brachycolus heraclei* Takahashi, on celery observed by Mr. Nishida and himself at Waialua, Oahu, April 26, 1945. Infestation was building up to an alarming extent on crops nearing maturity. The present shortage of nicotine sulphate for control of aphids and the shortage or unsatisfactoriness of substitutes for nicotine, is resulting in this aphid being a hazard to celery production. Moreover, because celery coming on to the market is often heavily infested with aphids, dealers have sought means of

removing the aphids from the harvested celery before it is placed on sale.

The first record of this species in Hawaii was secured by Dr. Holdaway on celery at Waialua, December 6, 1940. Since then it has been recorded by members of the staff of the Entomology Department of the Hawaii Experiment Station at many places on Oahu (Koko Head, Kaimuki, University campus, Hunnewell Street, Pauoa Road) and also at Lahainaluna School, Maui, and Haleakala homesteads, Olinda, Maui, and at Kamuela, Hawaii. If infestations of celery plants occur when plants are young, serious retardation of the crop may result. The importance of this aphid has increased considerably during recent years, since celery for the local market is now largely produced in Hawaii. The University extension service records an increase of production from 746,000 pounds in 1943 to 2,478,000 pounds in 1944.

*A new eriophyid on Hibiscus*—Mr. Look reported collecting a new species of eriophyid on hibiscus at Hilo, Hawaii, February 9, 1945. Mr. H. H. Keifer believes it to be an undescribed species of *Epitrimerus*, and is preparing figures of this mite. This mite is particularly abundant during dry weather. High infestations are found on young leaves, petioles and stems of the growing point. The infested leaves generally curl outward and turn reddish yellow, especially at the tips. Old leaves also turn yellow before dropping off.

*Mites on citrus*—Mr. Look reported that the cosmopolitan citrus rust mite, *Phyllocoptura oleivorus* (Ashmead) (det. H. H. Keifer), is one of the commonest mites on citrus plants at Hilo, Hawaii. A tarsonemid, probably the broad mite, *Hemitarsonemus latus* (Banks), is also destructive to seedlings and mature citrus trees. Papaya, potato, mango seedlings, dahlia, *Solanum nodiflorum* and *Bidens pilosa* are also commonly infested with tarsonemids.

*First records of aphids on Hawaii*—Mr. Look presented the following on aphids not previously reported from the island of Hawaii; the ten tabulated were identified by Prof. Essig.

Species	Host	Locality	Date
<i>Aphis ferruginea-striata</i> Essig	carrot	Hilo	Jan. 18, '45
<i>Aphis citricidus</i> (Kirkaldy)	pomelo	Hilo	Feb. 13, '45
<i>Aphis helichrysi</i> (Kaltenbach)	<i>Ageratum conyzoides</i>	Hilo	Feb. 9, '45
<i>Aphis rumicis</i> Linn.	<i>Phaius grandiflorus</i>	Hilo	Feb. 13, '45
<i>Capitophorus braggii</i> (Gillette)	African daisy	Hilo	Feb. 15, '45
<i>Myzus circumflexus</i> (Buckton)	hibiscus	Hilo	Feb. 9, '45
<i>Myzus convolvuli</i> (Kaltenbach)*	cucumber	Mountain View	Jan. 9, '45
<i>Myzus convolvuli</i> (Kaltenbach)*	rhubarb	Waimea	Jan. 19, '45
<i>Myzus ornatus</i> Laing*	rhubarb	Waimea	Jan. 19, '45
<i>Rhopalosiphum nymphaeae</i> (Linn.)	waterlily	Hilo	Feb. 14, '45
<i>Rhopalosiphum pseudobrassicae</i> (Davis)	mustard cabbage	Kamaili	Dec. 20, '44

\* Single alate.



Also reported by Mr. Look, but not new records, were the palm aphid, *Cerataphis lataniae* (Boisduval), and the banana aphid, *Pentalonia nigronervosa* Coquerel. Also observed in the field were *Aphis maidis* Fitch and *Brachycolus heraclei* Takahashi. *Toxoptera aurantii* (Fonscolombe) previously recorded on coffee at Kona by Illingworth (Proc. Haw. Ent. Soc., 7: 249, 1929) was also collected, breeding on *Macadamia*, hibiscus and *Vanda* orchid.

*Tromatobia rufopectus* (Cresson)—Dr. Swezey reported having found five egg "cocoon" of the spider *Argiope avara* Thorell in a tangle of web and dried leaves in a bush of *Duranta repens* in his garden, May 5, each of which contained cocoons of the ichneumonid predator *Tromatobia rufopectus*, with 8, 16, 18, 22 and 23 respectively per spider cocoon. From one spider cocoon the parasites had already issued; in another the parasites had died; in the other three cocoons the *Tromatobia* cocoons showed exit holes of the eulophid hyperparasite, *Pleurotropis wilderi* (Howard), and there were a few dead specimens of the latter. This was the first occurrence of these two parasites in his garden. The *Argiope* spider was not found, but one of its webs was observed a few months ago. In one spider egg cocoon were two pupae of the hyponomeutid moth, *Pyroderces rileyi* (Walsingham) from which moths issued later.

*Omphisa anastomosalis* (Guenée)—Dr. Swezey exhibited eggs of this pyralid moth, the sweet potato stem-borer, in a glass vial where they had been deposited by a female moth captured at light at his residence, May 12. Seventy eggs were laid, most of them attached to the surface of the glass, but a few free. They are very pale green, very shortly oval with a feeble reticulation on the surface, about half a millimeter in their shorter diameter, and slightly more than half a millimeter in their longer diameter. There is a sort of projection, or flange, on one side.

✓*Achaea janata* (Linn.)—Mr. Fullaway reported the capture of this recent immigrant on Kauai in May 1945, by Stephen Au. He exhibited a specimen of the encyrtid, *Habrolepis* sp., recently taken at the Territorial nursery, Honolulu, on lima bean. This is a rare insect, having been taken only twice before; nothing is known of its habits.

*Aneurobracon*, a synonym of *Mesocoelus*—Mr. Fullaway stated that his braconid species, *Aneurobracon samoanus* (Proc. Haw. Ent. Soc., 11: 45, 1941), should be known as *Mesocoelus samoanus* (Fullaway). *Aneurobracon* Brues 1930 being, according to C. F. W. Muesebeck, a synonym of *Mesocoelus* Schulz 1911 (Jl. Washington Acad. Sci., 25: 282, 1935).

JUNE 11, 1945

The 474th meeting was held at the H.S.P.A. Experiment Station on Monday, June 11, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Carter, Faxon, Jensen, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams, Wirth and Zimmerman.

*Visitors:* Messrs. Bernard Brookman, O. K. Courtney, R. D. Eichmann, R. B. Humphrey, J. Guy Lewis, E. M. Miller and J. J. Raynes.

Capt. W. W. Wirth was unanimously elected to active membership in the Society.

## PAPER

Dr. Williams presented his paper entitled "Psychoda pseudalter-nata, n.sp. (Diptera, Psychodidae)".

## NOTES AND EXHIBITIONS

*Bactra triculenta* Meyrick—Dr. Swezey reported a lot of the eggs of this nutgrass borer being 92 per cent parasitized by *Trichogramma minutum* Riley. A handful of fresh nutgrass leaves was collected from a cane field on the grounds of the H.S.P.A. Experiment Station, June 4. On examination, 13 of the moth eggs were found on the under surface of the leaves, in clusters of from 1 to 6. Twelve of them were parasitized by *Trichogramma*; this demonstrates why there is so little effect on nutgrass by the larvae of *B. triculenta*.

*Amyna natalis* (Walker)—Dr. Swezey exhibited specimens of an agrotid new to Hawaii, taken in a Navy light trap at Hickam Field, Oahu; a total of six specimens was taken on May 14, 19, 22, 23 and 26, 1945. The moth is known from India, Burma, Celebes, New Guinea, Australia, Fiji, Tonga and Samoa, but there is no information concerning its habits or importance. Hampson lists a few synonyms (Catalogue of the Lepidoptera Phalaenae in British Museum, 10: 461, 1910).

*Polydesma umbricola* Boisduval—Mr. Van Zwaluwenburg recorded the presence on Oahu of another agrotid moth new to the Territory, the second such immigrant to be found here within the past three weeks. Specimens were exhibited. On June 4, 1945, F. D. Kennedy of the H.S.P.A. Experiment Station submitted for identification, caterpillars and pupae collected by R. E. Mulholland at his residence, 1120 Koko Head Ave., Kaimuki, Honolulu. These insects were identified by Dr. Swezey as *Polydesma umbricola*. The species is recorded from West and South Africa, Madagascar, India, Ceylon, the Andamans, Burma, Formosa and Guam. Dr. Wil-

liams collected hatched cocoons near Noumea, New Caledonia, which Dr. Swezey identified as this species from pupal characters and from a larval head cast.

On June 5 Messrs. Williams, Rosa and Van Zwaluwenburg visited the Kaimuki address and found nearly mature larvae of *Polydesma* abundant in debris at the base of monkeypod trees (*Samanea saman* [Jacq.] Merrill). A few partially-grown larvae were found in dry blossom heads among the flower clusters near the ends of the branches. In the laboratory the caterpillars fed upon monkeypod foliage. In Guam, Dr. Swezey found the species associated with *Pithecolobium dulce* (Roxb.) Benth., but so far it has not been found on this tree in Honolulu. Dr. Williams' New Caledonia specimens were found under bark of *Albizia*. Pupation occurs under loose bark attached to the tree, and takes place within a tough cocoon of silk combined with more or less woody material. A few pupae were found under stones on the surface of the ground.

A brief survey showed *Polydesma* to be generally distributed on *Samanea* throughout Honolulu from Kaimuki to Moanalua. Later, on June 8, Dr. Swezey found the larvae at Waipio substation. Two adult moths (a male and a female) were taken on June 5 in the Experiment Station garage on Makiki Street. From the original Kaimuki material Dr. Swezey obtained puparia of *Eucelatoria armigera* (Coquillett); further evidence of tachinid parasitism of *Polydesma* was observed elsewhere about Honolulu.

*Eurytoma*, a new enemy of *Latrodectus*—Mr. Rosa reported that several egg cases of the spider *Latrodectus geometricus* Koch, collected by his daughter, Miss Mary Frances Rosa, May 11, 1945 on the H.S.P.A. Experiment Station grounds, yielded, a week later, adults of *Eurytoma* sp., an insect new to Hawaii. The *Eurytoma* larvae are predaceous on the spider eggs within the case. The species has been tentatively determined by Mr. Fullaway as *Eurytoma arachnovora* Hesse,<sup>5</sup> a South African species. The same parasite was later bred from *geometricus* eggs collected at the H.S.P.A. Experiment Station, Honolulu, May 18 by Mr. Pemberton, and at Maili Point, Oahu, May 23 by Mr. Van Zwaluwenburg. On May 31 Messrs. Rosa and Van Zwaluwenburg observed adult *Eurytoma* emerging from field-collected egg cases of *L. mactans* (Fabr.) at Lualualei, Oahu.

*Anacamptodes fragilaria* (Grossbeck)—Mr. Pemberton reported that the new immigrant geometrid, referred to earlier as *Stegania*, had now been determined by H. W. Capps of the U. S. National Museum, through Mr. Muesebeck, as *Anacamptodes fragilaria*. It is a native of southern California, but little is known there of its habits. It was described in the genus *Cleora* (Canad. Ent., 41: 194, 1909) but was later removed to *Anacamptodes* by McDunnough

<sup>5</sup> Later, after examining Hawaiian material, Dr. A. J. Hesse wrote that it is not this species. [Ed.].

(Dept. Agr. Canada, Bul. Ent. 18: 29, pl. v, fig. 10, 1920). Mr. Van Zwaluwenburg remarked that he recently found larvae of this species feeding on foliage of woodrose (*Ipomoea tuberosa*) at Maile, Oahu, under circumstances which precluded the possibility that they had dropped onto the vine from another food plant.

✓ *Achaea janata* (Linn.)—Mr. Van Zwaluwenburg reported finding at Waianae, Oahu, larvae of this agrotid feeding on *Leucaena glauca*, *Acacia farnesiana* and on *Prosopis chilensis* ("kiawe"). The last-named was found earlier by Mr. Wirth to be a food plant of *Achaea*.

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### JULY 9, 1945

The 475th meeting was held at the H.S.P.A. Experiment Station on Monday, July 9, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Carter, Jensen, Marlowe, Nishida, Pemberton, Rosa, Sakimura, Swezey, Tanada, Van Zwaluwenburg, Williams, Wirth and Zimmerman.

*Visitors:* Messrs. D. D. Bonnet, Bernard Brookman, E. D. Eichmann, E. J. Gerberg, Gilbert Gude, G. S. Starkey, G. S. Tulloch, J. P. Vinzant, J. E. Webb, Jr., and P. A. Woke.

### NOTES AND EXHIBITIONS

*A parasite of the onion moth*—Mr. Tanada reported that on March 23 larvae of the plutellid onion moth (*Acrolepia assectella* [Zeller]) were collected on green onions in a vegetable garden at the University of Hawaii; later several more larvae were collected. From this material issued two adult moths and two braconid parasites, *Chelonus blackburni* Cameron. The specimens were identified with the aid of Dr. Swezey.

*Megacerus alternatus* Bridwell—Dr. Swezey reported for C. J. Davis that the latter had collected 21 specimens of this bruchid at Keauhou, Kona, Hawaii, May 24, 1945, on an *Ipomoea*. Undoubtedly this plant was the usual beach species, *I. pes-caprae*, as that is the usual host plant of this beetle. Apparently this is the first collection of this bruchid on the island of Hawaii, although F. C. Hadden reported seeing its work at Kailua, Hawaii, in November 1929. The round holes in old seed capsules is always evidence of infestation by this bruchid.

*Omphisa anastomosalis* (Guenée)—Dr. Swezey gave the following observations on the life history of the sweet potato vine-borer. A female caught at light produced 70 eggs overnight in a vial, May 12. Eggs hatched May 18 (6 days). The young caterpillars were placed among numerous sprouts on a sweet potato in a jar. They entered the sprouts at the axils, and after finishing the sprouts,

entered the tuber itself, where they completed their growth. Pupation took place in silken cocoons in burrows in the tuber. The first pupae were found June 14 (27 days); the first moth issued June 26 (12 days) and moths continued to issue until July 9. Hence the length of the stages was as follows: Egg stage 6 days; caterpillar stage 27-36 days; pupal stage 12-16 days; total, 45-58 days.

*Ananca bicolor* (Fairmaire)—Mr. Bianchi exhibited discolored leaves from a stool of sugar cane upon which a large swarm of this oedemerid beetle had been perched for about a month. The discoloration apparently was the effect of some toxic content of the beetles' excrement. Isolated particles of excrement were in all cases surrounded by small discolored areas, and when enough of such areas joined, the whole leaf became chlorotic. Five or six stools, each with many leaves so affected had been pointed out to Mr. Bianchi in a cane field at Waialua Plantation, Oahu.

*Achaea janata* (Linn.)—Mr. Bianchi recorded this agrotid from the island of Hawaii for the first time. It was found on June 5, 1945 at Pahala, and on June 7 near the entrance to Puu Waawaa ranch. Caterpillars were abundant in both places on castor bean plants along the Mamalahoa highway.

*Baeus californicus* Pierce—Mr. Bianchi reported the first recovery of this scelionid parasite of *Latrodectus* eggs on the island of Hawaii, where it was liberated in 1939. He found it at South Point on June 7, 1945. Of 18 egg cases of *Latrodectus mactans* (Fabr.) collected, one contained both male and female *Baeus*. Males had not been seen before in the Territory, although they have been described from California; they are winged, in contrast to the apterous females.

*Latrodectus*—Mr. Rosa reported an egg case characteristic of *Latrodectus geometricus* Koch, produced by a field-collected female spider from Lualualei, Oahu, having the coloration of a typical *L. mactans* (Fabr.). The progeny of this egg case showed a wide variation in color and markings.

*Chaetogaedia monticola* (Bigot)—Mr. Rosa reported rearing this tachinid fly from pupae of the agrotid *Polydesma umbricola* Boisduval, a new host record.

*Heliothis attacking watermelon*—Dr. Jensen reported a general attack by the corn earworm, *Heliothis armigera* (Hübner), on watermelons on the island of Molokai. The infestation was examined by Joseph Boyd, truck crop specialist of the University of Hawaii extension service, on June 30. Specimens of the larvae and of damaged melons were brought to Honolulu by Mr. Boyd. The larvae were found attacking melons in all stages of growth from newly set fruits to mature melons. The tissue along the walls of the feeding channels usually became dry and corky, and fermentation developed within the melons. Some of the infested melons were partially

edible, but most of them were considered a total loss. Of the 56 acres of melons growing on Molokai last month, approximately 75 per cent suffered damage from corn earworm, with an estimated loss of 50 per cent of the entire crop, according to Mr. Boyd.

Three fields, of over 10 acres each, comprised most of the watermelon acreage. The attack was general over these fields as well as in smaller plots. The heaviest infestations occurred in the home-  
stead district, with lesser damage east of Kaunakakai. Although the literature records corn earworm larvae feeding on many host plants, no reference was found to extensive damage to watermelons by this insect. A few melon flies (*Dacus cucurbitae* Coquillett) were also reared from some of the melon samples brought from Molokai. However, the damage due to this insect was not considered severe during the past month.

*Paraidemona minnica* Scudder—Mr. Pemberton exhibited specimens of this grasshopper, found at Hickam Field, Oahu, on July 5, 1945, on grass and other low vegetation. The species was identified by Drs. Swezey and Williams. This is the first record of this acridid in Hawaii. It was described (Proc. U. S. Nat. Mus., 20 [1124]: 43-44, 1898) from material collected in Texas. The specimens collected at Hickam Field have been held in the laboratory for preliminary feeding tests, and have fed on grass, *Bidens pilosa*, and sparingly on sugar cane leaves, *Cyperus rotundus* and *Emilia flammea*. There are apparently no records of this species being of economic importance in Texas. However, it may well prove otherwise in Hawaii after it has become generally distributed.

*Polydesma umbricola* Boisduval—Dr. Williams spoke of finding this agrotid moth in its larval, pupal and adult stages on monkey-pod trees, *Samanea saman*, at Kawela, Molokai, June 19, 1945. This is a new island record. From its larvae were reared the tachinid, *Eucelatoria armigera* (Coquillett) and from the pupae, the ichneumonid *Ephialtes hawaiiensis* (Cameron), while a young caterpillar yielded a *Hyposoter exiguae* (Viereck) (Ichneumonidae). A chalcid, *Brachymeria obscurata* (Walker), issued from a *Polydesma* pupa. *Polistes* wasps were busy searching cracks and openings in the bark. A specimen of the ostomid (trogositid) beetle, *Tenebroides nanus* (Melsheimer), was found in this *Polydesma* material.

*Cryptorhynchus mangiferae* (Fabr.)—Dr. Williams reported that at Mapulehu, Molokai, the mango weevil did a great deal of damage in the larval state to mango seeds intended for planting, while in two instances the adults were observed with the beak inserted in a large fruit, one of which hung on the tree. This damage by adults would have lessened the market value. These observations were also made previously by George Otsuka, caretaker of the H.S.P.A. installations at Mapulehu.

*Metioche* sp.—Dr. Williams mentioned catching with a sweep net one of these tiny gryllids in his garden on upper Keeaumoku Street, Honolulu, late in 1944. The specimen was not preserved. Then on June 4 and 6, 1945, macropterous individuals apparently of this *Metioche* (determined by E. C. Zimmerman) were taken at a light trap operated by the Navy at Hickam Field. From June 10 on, other brachypterous forms were again taken in his garden. The genus occurs in parts of Oceania; it is a new record for Hawaii.

*Polemistus luzonensis* Rohwer—Dr. Williams reported taking this tiny wasp (Sphecidae, Pemphredoninae) on the grounds of the H.S.P.A. Experiment Station, Honolulu, on June 30, 1945, and on several days following. The wasps, which are presumably aphid hunters, were all males, and were flying up and down two posts containing small nail holes, and supporting a portion of one of the greenhouses. Others were later seen in similar flight alongside the trunk of a royal palm on the Station grounds. Dr. Williams first found this wasp in the Philippines in 1917, and from that material Rohwer described the species (H.S.P.A. Expt. Sta., Bul. 14, Ent. ser., pt. 1: 5-6, 1919). The wasp is new to Hawaii.

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#### AUGUST 13, 1945

The 476th meeting was held at the H.S.P.A. Experiment Station, on Monday, August 13, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Carter, Faxon, Fullaway, Hadden, Holdaway, Jensen, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams, Wirth and Zimmerman.

*Visitors:* Messrs. A. L. Block, D. D. Bonnet, Bernard Brookman, J. R. Douglas, R. D. Eichmann, Gilbert Gude, E. M. Miller, R. Z. Pepper and J. E. Webb, Jr.

Dr. Swezey was unanimously elected to honorary membership in the Society. The President remarked that such action was most fitting, Dr. Swezey having witnessed the formation and growth of the Society, and having been one of its founders.

#### PAPERS

On behalf of C. J. Davis and A. L. Mitchell, Mr. Pemberton presented a paper entitled: "Notes on Host Records of *Philaenus spumarius* (Linn.) at Kilauea, Hawaii National Park (Homoptera, Cercopidae)". For Mr. C. F. W. Muesebeck, Mr. Fullaway presented a paper entitled: "A new *Apanteles* from Hawaii (Hymenoptera, Braconidae)". Mr. Fullaway also presented Howard L. McKenzie's paper: "A new Species of *Lepidosaphes* attacking *Dendrobium* Orchids in Hawaii and California (Homoptera, Coc-

coidea, Diaspididae)". For Lt. Sherwin F. Wood, Dr. Carter presented a paper entitled: "The Occurrence of *Trypanosoma conorhini* Donovan in the Reduviid Bug *Triatoma rubrofasciata* (Degeer) from Oahu, T. H."

#### NOTES AND EXHIBITIONS

*Systole geniculata* Förster—Mr. Sakimura reported that this fennel seed chalcid, known from the Territory since 1930, was discovered causing damage to Chinese parsley, "yuen-sai" (*Coriandrum sativum*) in Manoa, Honolulu. This new host plant is a close relative of fennel and carrot. The larvae feed within the seeds, making them non-viable. Seeds from infested plants showed a very poor rate of germination. Identification of the insect was made by Dr. Swezey.

*Pamakani stem gall fly*—Mr. Fullaway reported that the trypetid fly, *Procecidochares* sp., which breeds in the stems of "pamakani" (*Eupatorium glandulosum*), is now established on Mt. Tantalus, Oahu, and in upper Kula on the island of Maui. The fly is an introduction from the Cuernavaca region of Mexico, by the Board of Agriculture. Since January, collections made by Mr. Krauss have been received frequently by air, and the adult flies either liberated or held for propagation. The fly is easily handled, and during the summer its numbers were increased many times by cage rearing. Fresh galls have been noticed on Tantalus for several months, but the establishment on Maui is very recent, for shipments to that island were not made until the middle of May.

*Eurytoma* sp.—Mr. Fullaway spoke of this new immigrant wasp, predaceous on eggs of *Latrodectus*. Specimens sent to the U. S. National Museum were reported by A. B. Gahan to be similar to a *Eurytoma* of similar habits from Puerto Rico, which may be identical with *E. arachnovora* Hesse\* from South Africa.

*Hercimothrips femoralis* (Reuter)—Mr. Bianchi reported heavy damage to bananas by this thrips at the Campbell plantation at Mokuleia, Oahu. In some of the western fields thrips are so abundant that hardly a bunch of fruit escapes without some damage, and in many cases every individual fruit is completely discolored. The eastern end of the plantation is less badly affected but, according to the manager, damage is on the increase there. In some fields the injury by thrips is aggravated by the work of red spider, the effects of drought and the difficulties currently impeding proper cultivation. When the thrips population on a fruit is relatively small the injury is a characteristic "silvering". When the number of thrips is great, or perhaps when their work is aggravated by red spider and other factors, each banana assumes a peculiar reddish color, which, while not affecting the edibility of the fruit, mars its appearance and lowers its market value.

\* See p. 476.



*Anacamptodes* on Molokai and Maui—Mr. Van Zwaluwenburg reported finding larvae of *A. fragilaria* (Grossbeck) on the south coast of Molokai on July 18, 1945; they were on kiawe (*Prosopis chilensis* [Molina] Stuntz) at various places along the main road from the Kamalo district, about eight miles east of Kaunakakai, to a point about five miles west of the town. Mr. Pemberton added that he had observed this moth at Haiku, Maui on July 26. These are new island records for the species, previously known only from Oahu and Kauai.

*Polydesma umbricola* Boisduval—Mr. Pemberton reported that Douglas J. Worcester and William Brandt had found this agrotid moth and its caterpillars abundant on monkeypod trees (*Samanea saman*) at Lahaina, Maui, early in July 1945.

*Orchidophilus peregrinator* Buchanan — Dr. Swezey exhibited specimens of this orchid weevil collected at a Nuuanu orchid garden in June. One hundred thirty-four specimens were given him by Dr. Carter, with the idea that there might be more than one species among them. However, upon comparison with a paratype specimen under a binocular microscope, all proved to be *O. peregrinator*. This indicates that this species is of more importance in Honolulu than Dr. Swezey realized when preparing his recent paper on "Insects Associated with Orchids" (Proc. Haw. Ent. Soc., 12: 343-403, 1945).

*Heliothis armigera* (Hübner)—Dr. Swezey exhibited a moth of the corn earworm reared from a uniformly green caterpillar found by him on a leaf of tree tomato (*Cyphomandra betacea* Sendtner), where it had been feeding extensively. He had at first thought the caterpillar might be a different species, but the moth which issued proved to be the same as a specimen reared from an ear of corn whose caterpillar had the usual corn earworm markings.

*Acrapex exanimis* (Meyrick)—Dr. Swezey exhibited specimens of this agrotid moth found among material from a wind trap operated by Mr. Sakimura in a pineapple field in the Kunia district, Oahu, March 9, 1943. It is the first specimen he had seen since 1927 and 1928, when he reared several moths from larvae boring in the stems of a grass (*Panicum torridum*) growing on the western slope of Koko Head, Oahu. The moth was described by Meyrick as a *Caradrina* (Fauna Haw. 1:153, 1899) from a single worn female collected in Kona, Hawaii by Dr. Perkins. It was redescribed by Meyrick from material reared by Dr. Swezey from Koko Head (Proc. Haw. Ent. Soc., 7: 92, 1928), and an account of its life history was given by Dr. Swezey (l.c.,: 179-181, 1928). More recently two specimens were found among material from a light trap operated in the Kunia district by Major J. E. Webb, Jr., of the 18th Medical General Laboratory. These moths must have flown down from the forest where *Panicum kaalense* grows, for Dr. Swezey

had found this grass with stems bored, along the trail near the base of Mt. Kaala, but had failed to find any larvae in the stems at the time.

*Weevil damage to Vanda orchids*—Dr. Holdaway reported that the orchid weevil, *Orchidophilus peregrinator* Buchanan, probably a native of the Philippines, has been causing serious injury in a large commercial orchid garden in Nuuanu Valley, and materially reducing the production of *Vanda* blooms. Injury results principally from the feeding of the adults on the buds, and the feeding of the larvae in the leaves and aerial roots. Since September 1944 studies on the control of the weevil have been undertaken in co-operation with William Kirch of the University Experiment Station orchid project and Robert Warne of Nuuanu. These studies, involving eight different chemicals, have extended from greenhouse experiments to studies on field control involving weevil counts and flower production in the orchid garden. The experiments, which have indicated the superiority of DDT over all other insecticides, will be presented in detail at a later date.

Other observations have indicated that this weevil is capable of serious injury also to *Phalaenopsis* and *Dendrobium* orchids. Dr. Swezey (Proc. Haw. Ent. Soc., 12: 346-348, 1945) records that the species has been intercepted at Honolulu on the following orchids from the Philippines: *Phalaenopsis schilleriana*, *P. amabilis* and *Grammatophyllum multiflorum*. He also states that the only record of its occurrence in Honolulu was in 1928 in the orchid house of the late Mr. F. C. Atherton, the first record of the weevil in Hawaii. Since the preparation of Dr. Swezey's paper, Dr. Carter (Proc. Haw. Ent. Soc., 12: 223, 1945) has recorded the weevil in *Vanda teres*. It is apparent from our observations during the past twelve months that this weevil has become entrenched in orchids on Oahu, and is capable of serious injury to the growing orchid industry.

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#### SEPTEMBER 10, 1945

The 477th meeting was held at the H.S.P.A. Experiment Station on Monday, September 10, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Faxon, Holdaway, Jensen, Keck, Pemberton, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams, Wirth and Zimmerman.

*Visitors:* Messrs. J. E. Alicata, E. W. Bushing, D. D. Bonnet, Bernard Brookman, R. D. Eichmann, E. M. Miller, J. J. Raynes and P. W. Weber.

Dr. Holdaway proposed Dr. J. E. Alicata for membership in the Society.

## PAPERS

Dr. Swezey presented two papers, one: "Some New Species of Cerambycidae from the Island of Hawaii (Coleoptera)", the other by himself and Mr. Zimmerman: "Synonymic Notes on *Argyroploce illepipa* (Butler) and *A. carpophaga* (Walsingham) (Lepidoptera, Eucosmidae)". Dr. Williams presented a paper entitled: "*Stigmatomma* (Fulakora) *zwaluwenburgi*, a new Species of Ponerine Ant from Hawaii".

## NOTES AND EXHIBITIONS

Additional host plants of *Polydesma*—On August 20, Messrs. Rosa and Van Zwaluwenburg found larvae and pupae of *P. umbri-cola* Boisduval under bark of *Albizzia lebbek* (Linn.) Benth. Evidence of feeding was abundant on the tender leaves. The next day numerous *Polydesma* larvae, large and small, were found in debris and under stones at the base of isolated *Pithecolobium dulce* (Roxb.) Benth. ("opiuma") trees, which had suffered considerable foliage damage. One *Erebus odora* (Linn.) was also found associated with opiuma. Dr. Williams found *Polydesma* on *Albizzia* in New Caledonia, and Dr. Swezey found it associated with *P. dulce* on Guam, but until now neither plant was known to be a host for this agrotid in Hawaii.

*Corn earworm infesting watermelon*—Dr. Holdaway commented on a recent record by Dr. Jensen of attack by corn earworm (*Heliothis armigera* [Hübner]) on watermelons on Molokai. This is apparently the first record of this species attacking watermelon. Speculation on the reasons for this infestation is of interest. During 1944 there was considerable wartime planting of corn on Molokai: 1,200 to 1,500 acres. During 1945 the acreage was somewhat less. By June 1945, when the infestation of watermelons was recorded, there was very little corn on the island. Kaunakakai, where the infestation occurred, is not in the direct line of the prevailing wind from the Kualapuu region where the large plantings of corn were. However, it seems quite probable that a large population of earworm moths developed in the corn were available for oviposition in the absence of the more favored host, corn. Some years ago a somewhat similar state of affairs was encountered when lettuce, not a normal host, was attacked by *Heliothis* larvae at Waimea, Hawaii. As a result, the moths oviposited on lettuce. The larvae caused injury to the lettuce, but could not be reared through to adults on that plant.

*A heavy infestation of corn aphid*—Dr. Holdaway reported heavy infestations of corn aphid, *Aphis maidis* Fitch, observed during the past two weeks on sweet corn at the Army farm, Kipapa airfield, Oahu. The infestation was so heavy that in two fields with corn

plants 3 to 4 feet and 5 to 6 feet high respectively, almost every plant is infested, many of them severely. In the older planting infestation must run to many thousands of aphids per plant; leaves are covered with a thick encrustation of aphids; leaves of badly infested plants are wilted, and some show a dry, chlorotic condition. It is reported that two years ago at about this time of year, heavy infestations also occurred. At that time a cessation of corn growing was followed by reduction of the trouble. These infestations are interesting from various angles. USDA-34 is apparently a variety very susceptible to corn aphid. Moreover, corn has now been grown continuously at Kipapa for several years, and thus there has been a continuous supply of susceptible food for building up a high population. It seems as though these two facts with a possible third—particularly favorable weather conditions for increase of the aphid—are responsible for the present infestation.

*Rhipidius* sp. in Hawaii—Dr. Williams exhibited several male specimens of this curious rhipiphorid beetle, new to Hawaii, which is probably parasitic in the cockroach, *Blattella germanica* (Linn.). Such a beetle was first observed as an interception on an Army plane from the South Pacific on January 25, 1944, when it was dissected out of an adult *B. germanica*. Later it was taken at light traps at Hickam Field and at Ewa, Oahu, by Mr. Wirth, who submitted the catch to Dr. Williams. The beetles are now in the H.S.P.A. Experiment Station collection with their dates of capture from late June to late August 1945. Hypermetamorphosis occurs in *Rhipidius* much as it does in the Meloidae. The male *Rhipidius* has flabellate antennae and short elytra; the female is apterous and larviform and remains within the body of its host. *Rhipidius pectinicornis* Thunberg (*R. blattarum* [Sundevall]) is European and has been introduced into the United States. Our species has not yet been determined.

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#### OCTOBER 8, 1945

The 478th meeting was held at the H.S.P.A. Experiment Station on Monday, October 8, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Carter, Faxon, Fullaway, Jensen, Nishida, Rosa, Swezey, Van Zwaluwenburg, Williams, Wirth and Zimmerman.

*Visitors:* Messrs. Bernard Brookman, E. J. Gerberg and G. S. Starkey.

Dr. J. E. Alicata was unanimously elected to active membership in the Society. Mr. Clifton J. Davis was nominated for corresponding membership.

It was unanimously voted to send \$50 to the Zoological Society of London, for the Zoological Record fund.

#### PAPER

On behalf of Dr. R. I. Sailer, Mr. Zimmerman presented a paper entitled: "The Synonymy and Distribution of *Trichocorixa reticulata* (Guérin-Ménéville) (Hemiptera, Corixidae)".

*Apanteles tapatapaoanus* Fullaway—Mr. Fullaway proposed the above new name for the braconid parasite of a sweet potato *Bedellia* from Samoa, described by him as *Apanteles bedelliae* (Proc. Haw. Ent. Soc., 11: 46, 1941) from material bred by Dr. Swezey. In naming this species the fact was overlooked that the name *bedelliae* had previously been used by Viereck (Proc. U. S. Nat. Mus., 40: 174, 1911) in describing an *Apanteles* bred from *Bedellia* at Washington, D.C. It was suggested to Mr. Fullaway by Mr. Pemberton that the two *Apanteles* might be identical, but after examination of many examples of the American species Mr. Fullaway states definitely that the Samoan species is different. Hence a new name is necessary, and *Apanteles bedelliae* Fullaway becomes *A. tapatapaoanus* Fullaway. *A. bedelliae* Viereck, introduced from Kansas during the past summer by the Board of Agriculture, is now established in a few localities on Oahu.

*Two aleyrodids new to Hawaii*—Mr. Zimmerman reported that Miss Louise Russell, of the U. S. Bureau of Entomology, has identified for him two aleyrodids not hitherto reported from the Territory. One is the iris whitefly, *Aleyrodes spiraeoides* Quaintance, from iris at Waiakoa, Kula, Maui, collected in April 1945. The other is *Aleyrodes shizuokensis* Kuwana, known to Dr. Swezey on *Oxalis* in his garden in Manoa Valley for the past 20 years. The iris-infesting species was described (U. S. Bur. Ent. Bul., Tech. ser., 8: 36, 1900) from California; Kuwana's species was described from Japan (Pomona Coll. Jl. Ent., 3: 620, 1911).

*Corn aphid infestation*—Dr. Holdaway and Mr. Nishida discussed further the infestation of *Aphis maidis* Fitch at Kipapa, Oahu, reported at the previous meeting. According to the field staff, aphid infestations had been heavy on repeated plantings of corn throughout the summer (since May or June). A parasite, apparently the braconid *Lysiphlebus testaceipes* (Cresson), present in the field when the earlier observations were made (during the first week of September), increased somewhat in abundance during September. Up to the last week of the month, however, it had not increased sufficiently to prevent heavy infestation of new corn plantings, so insecticidal control of the aphids was resorted to. Three applications of nicotine held the infestation down during the early growth of the crop, but, by the time the corn was 4 to 5 feet high and difficult to spray, heavy infestations had developed.

It was observed that aphids occurring in the "cone" of unfolded young leaves were not parasitized. During the last week in September heavy rains reduced aphid abundance considerably, while living aphids were removed from the leaves by the action of the rain, parasitized individuals remained. It is interesting to speculate on the possible result of the rainfall on the ultimate aphid population. The rains no doubt destroyed many adult parasites as well as aphids, but the parasitized aphids, protected from the mechanical action of the rain, may serve as a source of parasites to reduce the infestation more quickly than would have been possible without the aid of rain.

*Capitophorus chrysanthemi* Theobald—Dr. Jensen reported the occurrence in Hawaii of the above aphid, new to the Territory. Identification was by Prof. E. O. Essig after comparison with type material from the British Museum. Theobald described the species (Bul. Ent. Res., 11: 69, 1920) from material collected on chrysanthemum in South Africa; it occurs also in Egypt. Prof. Essig writes: "It is apparently of Chinese or Japanese origin. What I feel certain is the same species was described as *C. formosanus* by Takahashi from *Chrysanthemum sinensis* from Formosa in 1929." The record for Hawaii is based upon a single alate specimen collected by Dr. Jensen on chrysanthemum at Waipahu, Oahu, May 15, 1945. Although this host plant has been examined several times at Waipahu and elsewhere on Oahu, additional specimens of this aphid have not been found to date. The specimen from Waipahu was pale green in color and, in gross appearance resembled the potato aphid, *Macrosiphum solanifolii* (Ashmead), except that *C. chrysanthemi* is somewhat smaller and has darker, more conspicuous wing veins.

*Neoclytarlus dodonaeae* Swezey — Dr. Swezey said that four specimens of this cerambycid beetle had issued from a portion of *Dodonaea* trunk since the previous meeting of the Society, at which he presented a description of the species based on two specimens received earlier from C. J. Davis of the Hawaii National Park.

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#### NOVEMBER 19, 1945

The 479th meeting was held at the H.S.P.A. Experiment Station on Monday, November 12, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Bianchi, Carter, Fullaway, Holdaway, Jensen, Nishida, Rosa, Sakimura, Swezey, Van Zwaluwenburg, Williams, Wirth and Zimmerman.

*Visitors:* Messrs. G. F. Augustson, J. V. Benschoter, D. D. Bonnet, R. D. Eichmann, M. B. Folb, Gilbert Gude, M. S. Johnson, E. C. Nelson, R. Z. Pepper and P. W. Weber.

Mr. Clifton J. Davis was unanimously elected to corresponding membership in the Society. The name of Dr. David D. Bonnet was nominated for active membership.

#### PAPERS

Mr. Bianchi presented two papers: "Conocephalothrips tricolor, a new Urothripid from Hawaii", and "Additions to the Thysanoptera from the Island of Hawaii". Mr. Zimmerman presented two papers: "New Usingerius from the Philippines and Borneo (Coleoptera, Curculionidae)", and "Browne 1887, not Douglas 1888, the Author of *Orthezia insignis* (Homoptera, Coccoidea)", and, on behalf of Dr. Karl Jordan another, entitled: "On the Species of *Araecerus Schoenherr* known from the Hawaiian Islands (Coleoptera, Anthribidae)". Dr. Jensen presented a paper entitled: "The Identity and Host Plants of Blossom Midge in Hawaii (Diptera, Cecidomyiidae, Contarinia)".

#### NOTES AND EXHIBITIONS

*Coloradoa rufomaculata* (Wilson) — Dr. Jensen reported the presence in Hawaii of an aphid genus not previously recorded from the Territory. The aphid, *Coloradoa rufomaculata*, (*Aphis rufomaculata* Wilson. Ent. News, 19: 261, 1908), was identified by Prof. E. O. Essig from material collected on chrysanthemum by Dr. Jensen at Waipahu, Oahu, May 15, 1945. It occurred in large numbers on the terminal growth of the plants, and to a lesser extent on the under surface of the older leaves. Apterae were abundant, but winged forms were very scarce. However, several alates were reared in the laboratory. In life this aphid appears bright green in general color, but has an inconspicuous whitish bloom due to the numerous small, capitate hairs on the body.

The species has been recorded from *Artemisia vulgaris* var. *indica*, *Chrysanthemum sinensis* and *Siegesbeckia orientalis* in Japan, and from chrysanthemum in India, Egypt, China, Australia, England, New York, Pennsylvania, South Carolina, Colorado and California.

*A new eriophyid on mango*—On behalf of Mr. Look, Dr. Williams presented the following note: An eriophyid collected from mango leaves at Hilo, Hawaii, April 1, 1945, has been identified by H. H. Keifer as an undescribed species of *Oxypleurites*. Heavy infestations on a mature tree and on seedlings were observed by Mr. Look during periods of dry weather at Hilo.

*Graptostethus servus* (Fabr.)—Mr. Van Zwaluwenburg said that a specimen of this lygaeid bug, collected some days earlier at Olowalu, Maui, was received on October 11 from D. J. Worcester. This is a new island record for the species, previously known locally only from Oahu and Kauai.

✓ *Achaea janata* (Linn.)—Mr. Van Zwaluwenburg said that on October 12, R. E. Doty found a nearly full-grown larva of this immigrant agrotid feeding on *Euphorbia hirta* Linn. in Honolulu. This is the first record in Hawaii of this insect feeding on this host. Mr. Bianchi spoke of finding *Achaea* larvae feeding on *Codiaeum*, the ornamental croton, at Waialae, Honolulu. This is a new host record.

*Metioche* sp.—Mr. Rosa reported that he recently found this tiny cricket at Waianae, Oahu, as well as in his garden in Nuuanu Valley, Honolulu.

*Eurytoma* sp. on Maui—Dr. Carter reported that he had bred this recent immigrant which preys on eggs of *Latrodectus* spp., on the island of Maui, a new distribution record. The spiders are a pest of pineapples according to Dr. Carter, binding the growing, central leaves and causing abnormal growth.

*Ceroplastes rubens* Maskell—Dr. Carter reported finding this wax scale on a *Stanhopea* orchid plant in Honolulu.

Encyrtid parasites of *Pseudococcus brevipes* (Cockerell)—Dr. Carter said that *Anagyrus coccidivorus* Dozier and *Hambletonia pseudococcina* Compere, introduced from Central America and Brazil, were apparently doing good work on the pineapple mealybug in one locality in a Baldwin Packers field in west Maui, where the dominant ant was *Paratrechina longicornis* (Latreille), the so-called crazy ant. The parasitism was high, and pineapple wilt quite scarce.

*New insect records from Kauai*—Mr. Fullaway reported that Stephen Au, plant inspector on the island of Kauai, had recently submitted specimens from Koloa, Kauai, of the small cricket, *Metioche* sp., and of the new immigrant agrotid moth, *Polydesma umbri-cola* Boisduval. In an egg sac of the spider *Latrodectus geometricus* Koch, also from Kauai, *Eurytoma* sp. were present. This newly established predator on *Latrodectus* eggs was first found on Oahu in May, 1945.

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#### DECEMBER 10, 1945

The 480th meeting was held at the H.S.P.A. Experiment Station on Monday, December 10, at 2:00 p.m., with President Jensen in the chair.

*Members present:* Messrs. Alicata, Bianchi, Bonnet, Bryan, Carter, Faxon, Fullaway, Holdaway, Jensen, McBride, Pemberton, Rosa, Sakimura, Swezey, Tanada, Van Zwaluwenburg, Williams, Wirth and Zimmerman.

*Visitors:* Miss Mabel T. Chong, Messrs. R. D. Eichmann, M. B. Folb, M. S. Johnson, L. K. Jones, J. G. Lewis and H. F. Riley.

Dr. David D. Bonnet was unanimously elected to active membership. Mr. J. Guy Lewis was nominated for membership in the Society.



This being the annual meeting, the following slate of officers to serve during the coming year was presented:

President.....	N. L. H. Krauss
Vice-President.....	Kay Sakimura
Secretary-Treasurer.....	F. X. Williams
Additional Members of	{D. D. Jensen
Executive Committee.....	{C. E. Pemberton

There were no further nominations, and the above nominees were elected to office.

The revised Constitution of the Society, together with the amendments proposed at the preceding meeting, was unanimously adopted.

President Jensen relinquished the chair to Mr. Sakimura, the vice-president elect, and presented the annual presidential address: "Virus Diseases of Plants and their Insect Vectors, with special Reference to Hawaii".

#### PAPERS

Dr. Williams presented a paper: "Two new Species of Astatinae, with Notes on the Habits of the Group (Hymenoptera, Sphecidae)". Mr. Zimmerman presented his paper: "A remarkable new Pseudopsectra from Maui (Neuroptera, Hemerobiidae)", and for Dr. Usinger the latter's: "Notes and Descriptions of Ceratocombus (Hemiptera, Cryptostemmatidae)". Dr. Swezey presented a paper entitled: "New Species of Hawaiian Lepidoptera".

#### NOTES AND EXHIBITIONS

*Strumigenys (Cephaloxys) membranifera* Emery var. *williamsi* Wheeler—Dr. Williams recorded the finding of a single specimen, a worker of this hypogaecic myrmicine ant, in soil at the H.S.P.A. Experiment Station in October, 1945, a new record for the island of Oahu. The variety was described from specimens collected under moss near Olaa, Hawaii in April, 1932. (Proc. Haw. Ent. Soc., 8: 276, 1933.)

*Tenodera angustipennis* Saussure—Mr. Bianchi exhibited an egg case of this mantid which had yielded the callimomid parasite *Podagrion mantis* Ashmead, as well as a single specimen of the eupelmid *Cerambycobius cushmani* Crawford.

Parasites of *Procecidochares* sp.—Mr. Fullaway exhibited a jar of the pamakani gall-fly (*Procecidochares* sp.) with inclusions of *Diachasma tryoni* (Cameron) and *Eurytoma* sp. It is suspected that both these parasites developed on the trypetid gall-fly.

A new geometrid moth—Dr. Williams reported that a single specimen of a geometrid moth, unlike any previously known here, according to Dr. Swezey, was caught in a light trap at Kaneohe, Oahu, by Mr. Wirth on August 23, 1945. The moth is brown with darker wavy bands across the fore and hind wings.

Notes on Hawaiian Tendipedidae (Chironomidae)—Mr. Wirth presented the following notes:

## Tabulation of known Hawaiian species

	Named	Discussed by Williams (1944)* but unnamed	New
<i>Tendipes (Chironomus)</i> ...	1	1	1
<i>Tanytarsus</i> .....	1	..	2
<i>Spaniotoma</i> .....	1	3	..
<i>Metriocnemus</i> .....	..	2	..
<i>Telmatogeton</i> .....	3	2	..
<i>Clunio</i> .....	..	3	..
Total .....	6	11	3

*Tendipes* sp. A plain-winged *Tendipes* which may, on further examination, prove to be the same as specimens identified by Van Zwaluwenburg in late 1944 from a light trap at Hickam Field, has been taken in a light trap operated at Ewa, Oahu, in November, 1945. The Ewa specimens differ from *T. hawaiiensis* (Grimshaw) in lacking the pre-apical femoral dark bandings, the medial cross-vein is not infuscated, and details of the male genitalia are different. Typically the Ewa specimens are smaller than *hawaiiensis*, the brown markings are restricted, and the male antennae are more sparsely plumose.

*Tendipes* sp. A spotted-winged *Tendipes* from the Ewa light trap appears to be new to Hawaii. The first specimens were noted on October 25, 1945, and between that date and November 30, 65 females were taken in 27 trap-night's collections. Since only females have been taken, it is suggested that this species may be reproducing parthenogenetically. Dr. Williams collected a similar species in New Caledonia in 1940, including males.

*Tanytarsus* sp. Mt. Kaala, Oahu, November 6, 1945, W. W. Wirth. Nine males swept while swarming beside trail. A relatively large, black species with broad creamy bands on the tarsi. (*Tanytarsus lacteiclavus* Grimshaw is a small green species). New record for Hawaii, probably endemic.

*Tanytarsus* sp. Mt. Kaala, Oahu, November 6, 1945, W. W. Wirth. Two males swept while swarming beside trail. Black, smaller than the preceding species, with narrower bands (annulations). A new record from Hawaii, probably endemic.

*Metriocnemus* sp. Numerous specimens of what is probably the same as Williams' *Metriocnemus* no. 2 (l.c.: 165, 1944) were taken on Mt. Kaala, Oahu, by sweeping on August 22 and November 6, 1945.

*Clunio* sp. Edwards identified specimens sent him by Williams as three different new species of *Clunio* (l.c.: 170-171, 1944), each from a different locality on the Oahu coast. Numerous males, of which three had the wingless female attached in copulation, were taken December 1-5, 1945 in a light trap operated at Lanikai, Oahu.

\* Proc. Haw. Ent. Soc., 12, 154-171, 1944.

One male with attached female was taken in light trap operated at the Kaneohe Territorial hospital, about one mile inland.

*Clunio* sp. One male was taken in a light trap operated in Hilo, Hawaii at the Plague Laboratory in November, 1945. A different species from the Lanikai specimens. The first record of *Clunio* from the island of Hawaii.

*Notes on Hawaiian Heleidae (Ceratopogonidae)*—Mr. Wirth presented the following:

The four known species of Hawaiian heleids have been collected as follows:

1. *Apelma brevis* Johannsen. In light traps at Wheeler Field, Oahu, November, 1945; Schofield Barracks, Oahu, November, 1945; Lanai City, Lanai, October 10, 1945 (D. D. Bonnet). The last record is apparently the first from Lanai, though the species should have been present for a long time in the large pineapple plantings there.

2. *Forcipomyia ingrami* Carter. Commonly collected in light traps and by hand collections throughout Oahu, from the summit of Mt. Kaala (4,030 ft.) to sea level. What may be a different form has been taken in a light trap at Wheeler Field in November, 1945, as well as by hand collections from Manoa Valley, Kamananui stream and Mt. Kaala, all on Oahu. Females are much smaller and darker than typical *ingrami*, and the hairs of the mesonotum are black rather than golden. *F. ingrami* was also taken in the light trap at Hilo, Hawaii, in November, 1945.

3. *Dasyhelea calvescens* Macfie. Adults were abundant at Hanalei Bay, Oahu, the type locality, swarming over the rocks back of the shore. Larvae were taken from the felt-like growth of algae and diatoms in the shallow pools in the rocks receiving the splash from the sea at high tide.

4. *Dasyhelea hawaiiensis* Macfie. Commonly collected in light traps and by hand collections throughout Oahu, from Mt. Kaala to sea level. The Mt. Kaala specimens were entirely black, even to the tips of the halteres. Specimens taken in a light trap on Judd Street, Honolulu, were a brilliant yellowish green with small brown thoracic markings and with a black dorsal patch on the abdomen. Macfie (Stylops, 3:133-134, 1934) described the species from Hering Valley specimens which he characterized as brownish, with the scutellum and halteres paler. Either this species is exceedingly variable, or characters may be found which will definitely separate what is probably a highland, from the lowland, form. A series of adults collected at one of the falls in upper Manoa Valley exhibits a wide range in color variation, from yellow to dark brown. The extreme color forms also differ markedly in the distribution of macrotrichia on the wings. *D. hawaiiensis* was also taken in the light trap in Hilo, Hawaii, on November, 1945; this is apparently a new island record for the species.

## LEHR ARTIMAN WHITNEY

1890-1945

The death of the veteran entomologist and plant quarantine inspector, Lehr Artiman Whitney, occurred February 21, 1945, after a lingering illness. At his death Mr. Whitney was 54 years of age. During the past quarter century his residence had been in Honolulu.



LEHR ARTIMAN WHITNEY

Mr. Whitney was born September 25, 1890, in Nevada, Iowa, but most of his early life was spent in California, where he attended school in the town of Orange. As a young man he worked in the orange groves of southern California, and it was there undoubtedly that he became interested in the pest problems of the horticulturist, an interest which eventually led to his adoption of the career of agricultural inspector. From 1911 on, he was contributing notes on insect pests to the monthly bulletin of the California State Commissioners of Horticulture. In 1920, while working with his brother, B. B. Whitney, in the San Francisco office of the state quarantine service, he was engaged by the Hawaiian Board of Agriculture and Forestry to take the place vacated by D. B. Langford,

as assistant to the late E. M. Ehrhorn. On the retirement of Mr. Ehrhorn in 1926, Mr. Whitney became the active head of the plant quarantine service and made a record there for quiet, efficient handling of the plant quarantine work.

Despite heavy physical handicaps, Mr. Whitney achieved distinction as a coccidologist, and his collection and study of coccids made him a valuable worker in the entomological field here, where these insects had long been neglected. Together with his wife Bernice, he spent much time also on the Diptera. In 1937 Mrs. Whitney died, and the loss of his wife was a blow from which Mr. Whitney never recovered. He became severely ill in 1939, and although he lived on beyond the expectation of everyone, his professional life was ended.

Mr. Whitney was a prominent Mason, and the Masonic memorial service conducted over his ashes was attended by the members of a committee from the Hawaiian Entomological Society. Mr. Whitney is survived by two brothers in California, one of whom, Mr. Blenn B. Whitney, has already been mentioned. The other is Mr. Mervin M. Whitney of Long Beach, California.

D. T. FULLAWAY

F. X. WILLIAMS

## THE APHIDIINAE OF NORTH AMERICA\*

(A REVIEW)

By D. T. FULLAWAY

This is an excellent treatise on an important group of insects not reviewed in America for a third of a century. Dr. Smith's work is thorough and painstaking, and adds considerably to our knowledge of these primary parasites of the aphids. Three new subgenera and twenty-six new species are made as a result of the revision, and six names are newly synonymized. There is a chapter on methods of study, general biology of the Aphidiinae, and the author's view on the important taxonomic characters; also a host index of species studied by the author, and a bibliography. The illustrations are of the author's own making and should be useful in the discrimination of the species. The three species known in Hawaii are included in the treatment, but the reviewer has not yet tested the accuracy of their determination by the method Dr. Smith uses for species discrimination.

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\* By Dr. Clyde F. Smith (Contributions in Zoology and Entomology, 5, Ohio State University, vii + 154 pp., 17 pls., 1944.)

Proc. Haw. Ent. Soc., Vol. XII, No. 3, May, 1946.



## REVISED CONSTITUTION

(Adopted at the meeting of December 10, 1945)

ARTICLE 1. *Name.*

The name of this organization shall be the Hawaiian Entomological Society.

ARTICLE 2. *Objects.*

The objects of the Society shall be to promote the study of entomology, and to encourage friendly relations between those interested in the science.

ARTICLE 3. *Members.*

The Society shall consist of Active, Junior, Corresponding and Honorary members. No corresponding member shall be elected from residents on the island of Oahu. Junior membership shall be limited to those under eighteen.

Election shall be by ballot, nomination having been made by a member of the Society at a previous meeting. A majority vote of Active members present shall be necessary for election.

The annual dues for Active members shall be five dollars, for Junior members two dollars and fifty cents, and for Corresponding members two dollars, unless election takes place after the last day of September, when no fees shall be collected for that year. Active members who move away permanently shall become Corresponding members on the January first following their departure. Honorary members, and ladies who are Active members, shall be exempt from dues.

Any member in arrears for one year may, after due notification, be dropped from the rolls. No member in arrears shall be entitled to a vote or to the Proceedings of the Society for that year.

ARTICLE 4. *Officers.*

The officers of the Society shall be a President, a Vice-President and a Secretary-Treasurer to be elected by ballot at the annual meeting. These officers, together with two Active members to be elected by the Society in the same manner as the officers, to form an Executive committee. The Executive committee shall constitute a nominating committee for said officers of the Society, and shall present a slate of officers to the Society. Nominations may also be made from the floor.



ARTICLE 5. *Duties of Officers.*

(a) The duty of the President shall be to preside at the meetings of the Society and committees, and regulate all the discussions and proceedings therein, and to execute or see to the execution of the By-Laws. In case of an equality of vote, the President shall have a double or casting vote. It shall be the duty of the President to deliver an address at the closing meeting of the year.

(b) In the absence of the President the Vice-President shall fill his place, and shall for the time being have all the authority, power and privilege of President.

(c) In the absence of the President and Vice-President a chairman protem shall be elected by a majority vote of Active members present.

(d) The Secretary-Treasurer shall conduct all the correspondence of the Society, keep a list of members, give due notice of all meetings and take and preserve correct minutes of the Proceedings of the Society; shall have charge of all monies of the Society, collect all dues, assessments, receipts and contributions, make disbursements under direction of the Executive committee, and submit a report of the state of finances of the Society at the annual meeting or whenever called for.

(e) The Executive committee shall appoint one or more Active members from among themselves or otherwise, as Librarian, Curator and Editor, respectively, and two additional members to constitute with the Editor an editorial committee. The Editor's duties shall be to edit the publication of the Society and arrange for their publication. The Librarian and Curator shall have custody of the library and collections respectively and shall manage them under the direction of the Executive committee.

ARTICLE 6. *Meetings.*

The regular meetings shall be held, unless otherwise ordered by the Executive committee, on the second Monday of each month. The annual meeting for the election of officers shall be the regular meeting for the month of December. Special meetings may be called by the Executive committee or by the President at the written request of five Active members. Five members shall constitute a quorum for the transaction of business.

ARTICLE 7. *Amendment.*

The Constitution may be amended at any regular meeting by a two-thirds vote of Active members present, a copy of each amendment proposed having been presented at the preceding regular meeting.

ARTICLE 8. *Order of Business.*

- (a) Reading and approval of minutes.
  - (b) Reports of officers and committees.
  - (c) Nomination and election of members.
  - (d) Nomination and election of officers at annual meeting.
  - (e) Unfinished and new business.
  - (f) Presidential address at annual meeting.
  - (g) Presentation of papers.
  - (h) Presentation of notes and exhibitions.
  - (i) Motion to adjourn.
- 

Earlier references to the Constitution of the Society are to be found in the Proceedings as follows:

- 1: 5-8, 1905.
- 1: 60, 1906.
- 2: 42-44, 1909.
- 4: 249, 257-260, 1919.
- 7: 388-389, 1931.
- 8: 221, 1933.
- 10: 16, 18, 1938.



## Conocephalothrips tricolor, a New Urothripid from Hawaii

By FRED A. BIANCHI

Experiment Station, H.S.P.A.

(Presented at the meeting of November 19, 1945)

The superfamily Urothripoidae consists of the single family Urothripidae, comprising seven genera and about 25 species. Of these only the Australian *Octurothrips pulcher* Priesner (Konowia, 10: 10, 1931) and the American *Stephanothrips occidentalis* Hood and Williams (recorded in Proc. Haw. Ent. Soc., 8: 503, 1934) have been found in the Pacific region. It is of interest, therefore, to add to the family a well differentiated eighth genus, the circumstances of whose discovery indicate, if not necessarily its endemism in Hawaii, at least the probability of its ancient establishment in these islands. The two specimens upon which the new species and genus are based were found at an elevation of some 4,000 feet on the small, swampy and almost continuously rainy plateau which crowns steeply-sloped Mount Kaala and which, until the construction of a cable trolley some four years ago, was the most thoroughly isolated area of its size on the island of Oahu.

Distinguished at once from the rest of the family by the greatly protracted vertex of the head, the new genus is apparently most nearly related to Bagnall's *Urothrips* (Ann. Mus. Nat. Hung., 7: 126, 1909). It is like *Urothrips* in the shape and number of antennal segments, in the lack of tarsal armature of any kind, and in the absence of prominent bristles on the vertex of the head. It is unlike *Urothrips*, on the other hand, in the possession of white subhypodermal pigment, in the lack of heavy reticulation, in having four instead of six major terminal hairs, and in having both the maxillary and the labial palpi unmistakably two-segmented. The description follows:

### Conocephalothrips gen. nov.

Antennae inserted ventrally, seven segmented; segment 3 with narrow pedicel; segments 3, 4, 5 broadly joined; segments 4, 5 about as broad as long; segments 6, 7 narrower than long, broadly pedicellate. Vertex conical, produced far forward of eyes and antennal bases, without prominent bristles. Tarsi without claws or spurs. Tube about six times as long as wide and considerably longer than abdominal segment 9; tip of tube with four long hairs separated by minor ones. The genotype is:

**Conocephalothrips tricolor** sp. nov. (Plate XXVIII, figs. A, B, C)

Female: Length about 1.4 mm. Color by direct light, light chestnut brown; eyes, dark red. Head, thorax and abdominal segments 1, 2, 3 a shade darker than rest of abdomen; femora, end of tube, antennal segments 6, 7 concolorous with, or darker than head and thorax; tibiae shading from concolorous with head and thorax at base to pale (concolorous with antennal segments 1 to 5) at end. Subhypodermal pigment of two kinds, red and white; red more dense and conspicuous on periphery of head, all of thorax and abdominal segments 2 and 3, and on sides of abdominal segments 1 and 4 to 8; sparse in fore femora and absent from other femora and abdominal segments 9 and 10; white opaque, visible only by direct light and apparently more dorsal in position than red, present across distal half of pterothorax, all of abdominal segment 4, and on median third of abdominal segments 5 to 8. Pseudo-spiracles indistinctly discernible as more or less clear circular areas on sides of abdominal segments 1 to 8. Ventral surface of whole body smooth; dorsal surface rough, with small setigerous tubercles which are most prominent on head and legs. Narrow anastomosing striae faintly visible on tube and legs.

Head slightly wider basally than length from base to eyes, with vertex produced forward of eyes into a cone which is half as long as the rest of head. Eyes small, more or less circular in outline, consisting of about 10 relatively large facets placed entirely dorsad on the anterior angles of the head. Antennae seven-segmented, inserted ventrally a little inward from anterior angles of the head, with their bases separated by a distinct, short, shallowly emarginate inter-antennal costa. Antennal segments shaped as illustrated; 4 and 5 with two more or less dorso- and ventro-lateral sense cones; 6 and 7 with one cone each; the sense cones and antennal hairs thin, colorless and difficult to distinguish. Mouth cone broadly rounded at end and about two thirds as long from basal suture as distance between this suture and inter-antennal costa. Maxillary and labial palpi clearly two-segmented, with basal segment minute in both cases. Labrum dark and blunt at end, much shorter than labium.

Pronotum about seven-ninths as long as head without vertex, somewhat wider in back than front margin; the sides in reality somewhat concave in the middle as illustrated but, because of an optical effect difficult to explain, seemingly sharply notched above the front edge of the coxae; each hind angle armed with a short, stout, apically expanded seta mounted on a prominent tubercle. Pterothorax just a little shorter than prothorax, considerably wider in back than in front, with sides pronouncedly arched; the dorsum clearly divided into two transverse plates of equal length by a dark suture which arches forward at each end. Legs short and thick; the fore pair somewhat incrassate, and all beset with tubercles of which all but one or two on the inner edge of the fore femora are minute and setigerous. All femora with a long strong hair ventrally near the base. Hind coxae somewhat larger than the others and farther apart, as normal to the family. All tarsi normal, with darkened cup and without claws or spurs.

Abdomen widest at second segment, thence gradually and evenly narrowed to base of 9, which is conical, elongate and more acutely narrowed in its distal half. Segments 3 to 8 of about equal length; their hind angles somewhat produced and each armed with one stout seta which is blunt at the end on all but segments 7 and 8; without marginal or intermarginal hairs, except for two rather long strong ones medianly on the hind ventral margin of segment 8. Tube nearly 1.3 as long as segment 9 and only a sixth as wide as long; gradually widening from the middle to the last fifth and thence more suddenly narrowed again to the end; with four long pale hairs at the tip separated by minor setae.

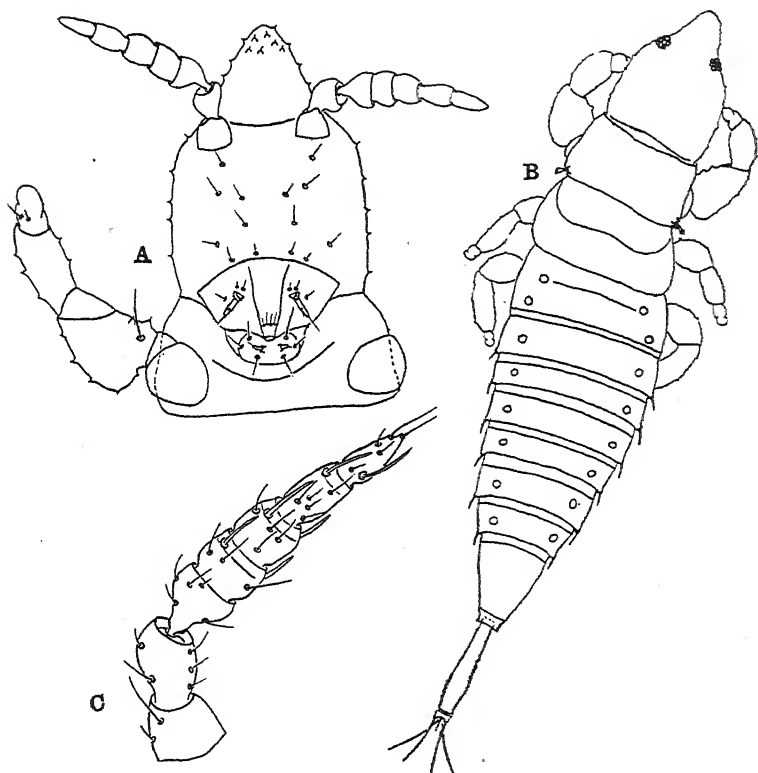


PLATE XXVIII

*Conocephalothrips tricolor* sp. nov.

- A—Ventral view of head and prothorax, showing antennae and right leg.  
B—Dorsal view of complete insect, with terminal setae abbreviated.  
C—Dorsal view of left antenna.

## Measurements of female paratype in mm.:

Antennal segments	1	2	3	4	5	6	7
Length .....	.. .0369	.0287	.0205	.0246	.0287	.0328	
Width .....	.. .0287	.0287	.0287	.0246	.0164	.0123	

Head, median length .225; head, from base to hind corner of eye .147; head width at base .184; head width across eyes .164; mouth cone from basal suture .098; median length of pronotum .114; width of pronotum, including coxae .246; median width of fore femur .073; median length of 9th abdominal segment .143; greatest width of 9th abdominal segment .123; length of tube .192; greatest width of tube, at 4/5 from base, .032; length of longest distal hairs .055; greatest width of abdomen, second segment, .184; length of setae on hind angles of prothorax .020.

Described from two females found on a leaf of *Broussaisia arguta* Gaud., Mt. Kaala, Oahu, on November 3, 1944. Both specimens, type and paratype, have been deposited in the collection of the Hawaiian Sugar Planters' Experiment Station, Honolulu. The male is unknown.

It is of interest to point out that the arrangement of the terminal setae in the new genus is typical of most Tubulifera, unlike that reported in the description of *Urothrips paradoxus* Bagnall. The four major hairs are separated by minor pointed setae dorsally and laterally, and by a pair of minute, blade-like setae (Buffa's "palettes") ventrally. In addition, as further evidence of the now unquestioned tubuliferous nature of the Urothripidae, it is worth noting that the paired pori found on the lateral or dorsal surfaces of the tube in every species of Tubulifera are also plainly visible in the new Urothripid. They are about 4 microns in diameter and close to the sides of the tube, on about the basal third.

As for the unexplained organ which Bagnall noted "on the under side of the ventral plate" of the ninth abdominal segment in *Urothrips paradoxus*, it is also found in my new species and appears to be an internal thickening of the body-wall. Perhaps it serves as a point of attachment for muscles of the ovipositor, or is in some other manner related to this blade-like organ, which in my specimens is visible through the body wall, lying along the midline of the segment and reaching from very near to the above mentioned thickening to the smaller rod-like thickening of the hind ventral margin which marks the genital opening.

## Additions to the Thysanoptera from the Island of Hawaii

By FRED A. BIANCHI

H.S.P.A. Experiment Station

*(Presented at the meeting of November 19, 1945)*

This paper adds 25 species of thrips to the 29 previously listed by Sakimura and Krauss and by Bianchi (Proc. Haw. Ent. Soc., 10: 1945) from the island of Hawaii. It includes a miscellany of unpublished records accumulated over a period of years in the collections of the writer and others, but is based mainly on the results of extensive and careful collecting which Mr. Clifton J. Davis did during 1945 and the latter months of 1944.

Stationed at Kilauea as park ranger, Mr. Davis is taking excellent advantage of the opportunities afforded by his situation, and his collections and careful investigations have already added greatly to our knowledge of all the orders of insects on the Big Island. In the Thysanoptera his material comprises a great many lots of the more common species, with careful notations as to habits and host plants; but for the sake of brevity only those species are mentioned here which have not been previously recorded from the island.

One of the species is new to the Territory; three are new to science and are now named and described for the first time. With these, the Thysanoptera from the island of Hawaii are run up to 51 specifically determined species, not including several species listed by Sakimura and Krauss only under the generic name, nor two or three species which are represented in my own collection by material too meager to warrant description at present. Since our native thrips appear to be characterized by secretiveness and scarcity, it is very probable that other species, possibly many, remain to be found.

In the following list the initials H.N.P., C.J.D., and F.A.B. refer respectively to the general locality, Hawaii National Park, and to the collectors, Clifton J. Davis and F. A. Bianchi.

### TUBULIFERA

#### **Haplothrips davis** sp. nov. (Plate XXIX, fig. D; Plate XXX, fig. D)

Brachypterous female: Length, not including inter-segmental membranes, about 1.3 mm. Color by transmitted light chestnut brown; extreme base of antennal segment 3, all tarsi and extreme ends of tibiae, lighter. Subhypodermal pigment reddish. Striation very fine, visible only in clear specimens, composed of transverse anastomosing lines, more apparent on dorsum of head, mesoscutum, first abdominal tergite, base of tube.



Head about 1.1 as long as wide, widest in the middle; the cheeks weakly arched to caudal fifth or sixth, which is very slightly narrowed. Vertex declivous to base of antennae, weakly or not at all convex in front. Eyes about one fourth as long as head and about one fourth as wide; dorsally almost semicircular on the inner outline and ventrally weakly, roundly produced at the inner caudal angle. Facets large and regular in size, only about 4 on the outer outline of the eye, a few microsetae among them. Ocelli vestigial or entirely absent. Three or four very minute setae around inner outline of eyes and two on vertex; a few others on cheeks and dorsum of head. Postocular spines more than 1.5 as long as the eyes and set about half the eye length from their posterior margins, a little less than the same distance from the cheeks. Mouth cone about two thirds as long as head, conical, rounded at end; labrum dark-tipped and slightly surpassing labium; maxillary palpi long and thick, about half as long as mouth cone.

Antennae about twice as long as head; the inter-antennal costa short, straight across end and about a fifth as wide as basal antennal segments. Antennal segments as illustrated; the third, fourth, and fifth with wrinkle ventrally near end, upon which are inserted setae somewhat stronger and longer than the others of the segment. Two lateral sense cones on segments 3 to 6 and one dorsad on segment 7; those on segment 4 strong and blunt at end, those on other segments somewhat thinner and more acute. Porus on segment 2 conspicuous. Antennal hairs pale but in general strong and conspicuous.

Prothorax about .9 as long as head and not including coxae about 1.5 as wide as head; the fore and hind margins weakly arched; the sides more strongly divergent from anterior angles to middle than from middle to posterior angles; the median suture short, wavy. The usual major setae pointed, except anteroangulars and anteromarginals which are sometimes blunt or weakly expanded at end; the pair at each posterior angle longest, about equal to one another and to postoculars; midlaterals, anteromarginals and anteroangulars successively shorter; coxals subequal to midlaterals and inserted on the ventral surface of coxae.

Pterothorax subquadrate, about .266 mm. long on midventral line (including first abdominal sternite) and about .254 mm. across anterior angles, very slightly tapered caudally. Fore tibiae and fore femora somewhat thicker than others; fore tarsi armed with the usual claw on the outer surface and a minute tooth on the inner surface of the basal segment.

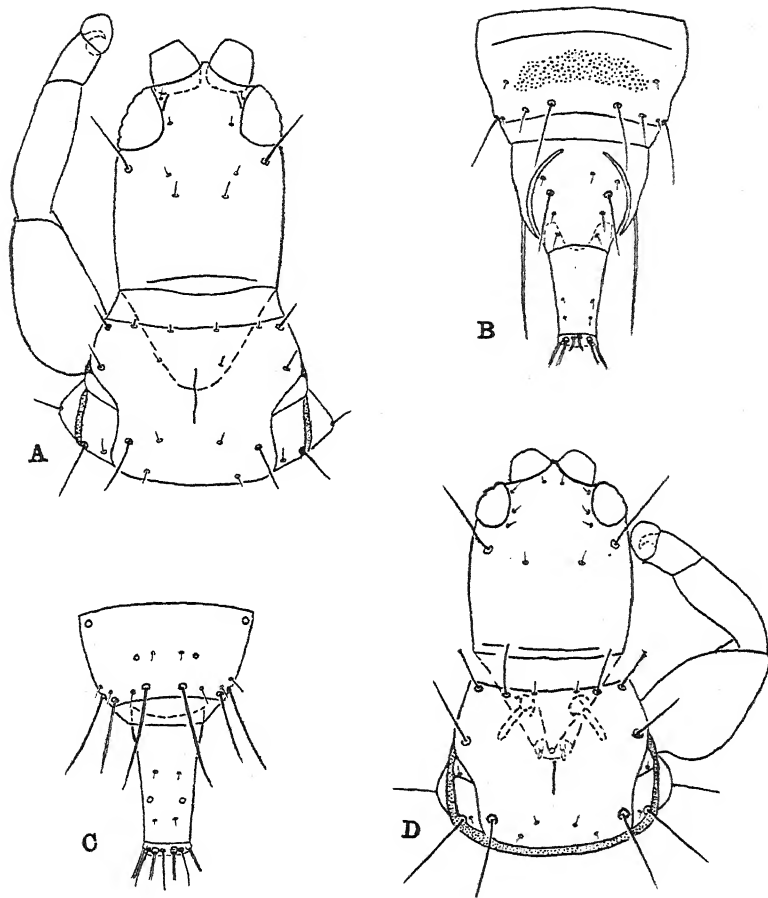
Abdomen long and heavy, widening gradually to segment 6; major setae light brown, long and pointed; those on segment 9 a little shorter than terminals and 1.5 as long as tube. Tube about .75 as long as head; nearly twice as wide at base as at end and tapering evenly from basal fifth; paired pori conspicuous and on about the distal third of dorsal surface.

Measurements of type (brachypterous female treated with KOH) in mm.: Head length .147; head width across cheeks .143; eye length .036; prothorax length .131; prothorax width including coxae .254; pterothorax length on midventral line .266; pterothorax width on anterior angles .254; abdomen width on segment 6 .299; tube length .110; tube width at base .061; tube width at end .032; longest setae on segment 9 .164; longest setae on tube .184; coxals .164; epimerals .069; posteroangulars .069; midlaterals .061; anteroangulars .032; anteromarginals .045; postoculars .069.

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.028	.041	.041	.041	.041	.041	.041	.028	.302

Brachypterous male: Colored like female; slightly smaller, about 1.12 mm. long. Abdomen equal in width to segment 6, thence tapered caudally. Posteroangular setae on segment 9 reduced (about .036 mm. long), stout and stiff.

Measurements of male allotype (brachypterous; treated with KOH) in mm.: Body length 1.12; head length .123; head width across cheeks .131; prothorax length .102; prothorax width including coxae .221; pterothorax



## PLATE XXIX

A—*Haplothrips rosai* sp. nov. Head, prothorax and left fore leg of brachypterous female, not showing all minor setae.

B—*Haplothrips rosai* sp. nov. Ventral view of abdominal segments 8, 9, and 10 of brachypterous male, showing median granulose depression on 8th ventrite, terminal bristles abbreviated.

C—*Haplothrips rosai* sp. nov. Dorsal view of abdominal segments 9 and 10 of brachypterous female, with terminal bristles abbreviated.

D—*Haplothrips darvizi* sp. nov. Head, prothorax and right fore leg of brachypterous female, not showing all minor setae.

length including first abdominal sternite .205; pterothorax width across anterior angles .213; abdomen width on segment 6, .209; tube length .090; tube width at base .053; tube width at end .028.

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.028	.041	.036	.041	.041	.041	.041	.028	.297

Described from the following material: One female paratype from *Metrosideros* leaves, Kilauea, April 14, 1944, N.L.H. Krauss, coll.; one female paratype from *Acacia koa* branches, H.N.P., March 10, 1945, C.J.D., coll.; male allotype from *Acacia koa* branches, Mauna Loa truck trail, H.N.P., 6,500 ft. elev., April 20, 1945, C.J.D., coll.; one male paratype from dead branch of *Metrosideros*, Makaopuhi, H.N.P., 2,870 ft. elev., July 6, 1945, C.J.D., coll.; two female and two male paratypes on old dead branches of *Pipturus*, Thurston lava tube, H.N.P., July 16, 1945, C.J.D., coll.; three female and four male paratypes on old dead branches of *Sophora chrysophylla*, Mauna Loa truck trail, H.N.P., 5,500 ft. elev., August 24, 1945, C.J.D., coll.; female holotype and one female paratype from dead branch of *Acacia koa*, Mauna Loa truck trail, H.N.P., 6,500 ft. elev., August 25, 1945, C.J.D., coll.

In addition to the type series, I have a number of specimens collected by Mr. Davis on later dates.

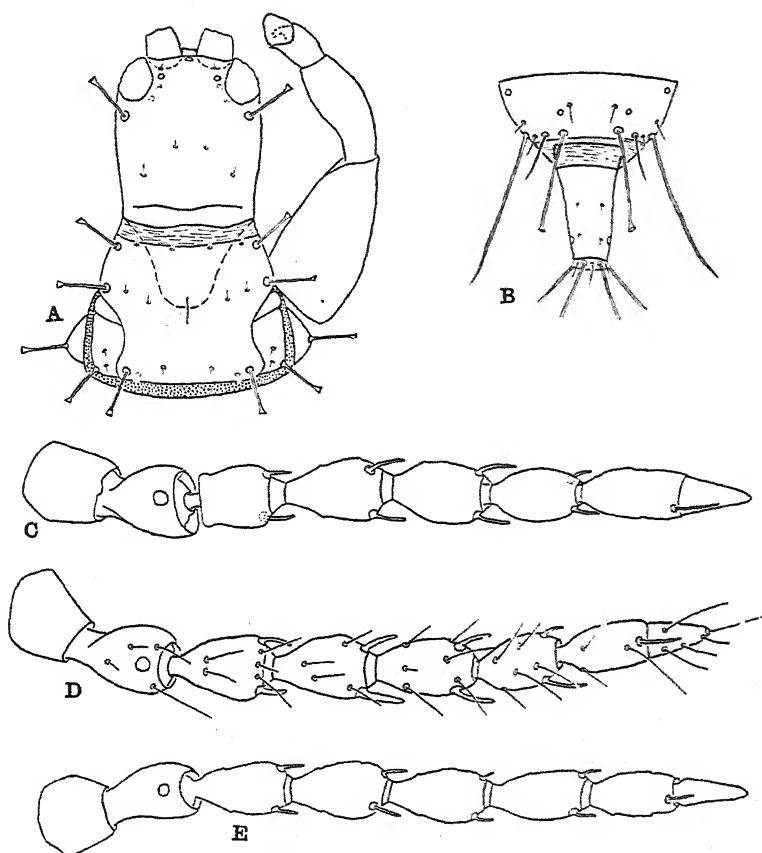
*Davisi* fits well in the *Haplothrips* and, like most species of the genus, it is a difficult one to characterize. However, from other species found in Hawaii it can be separated easily by its long pointed setae, of which only the anteroangulars and anteromarginals on the pronotum are likely to be, but are not always, slightly expanded at the end. It is not without hesitation that I describe it from material which does not include forms possessing functional wings and ocelli, but I feel justified because the species appears to be a common one in the Kilauea region and our collections indicate that it is very probably a prevailingly brachypterous species of which the macroppterous forms, if such ever occur, may never be found.

I take pleasure in naming the species after Mr. Clifton J. Davis whose collaboration has made possible the writing of this paper and who has in many ways added to the pleasure of my visits to Hawaii.

***Haplothrips rosai* sp. nov.** (Plate XXIX, figs. A, B, C; Plate XXX, Fig. E)

Brachypterous female: Length not including inter-segmental membranes about 1.43 mm. Color by transmitted light dark chestnut brown; all tarsi light yellowish brown and fore tibiae shading to same color at end. Eyes black; subhypodermal pigment red. Striation fine, composed of transverse anastomosing lines, more apparent basally and laterally on dorsum of head, on abdominal tergite 1, and dorsally at base of tube. All spines clear brownish yellow.

Head about 1.14 as long as wide; the cheeks normally roundly, weakly constricted back of eyes and thence practically straight to base of head, but in some specimens divergent caudally, causing the head to appear widest at



## PLATE XXX

A—*Karnyothrips doliicornis* sp. nov. Head, prothorax and right fore leg of brachypterous female, not showing all minor setae.

B—*Karnyothrips doliicornis* sp. nov. Dorsal view of abdominal segments 9 and 10 of brachypterous female, with terminal bristles abbreviated.

C—*Karnyothrips doliicornis* sp. nov. Dorsal view of left antenna of brachypterous female, with all setae omitted.

D—*Haplothrips davisii* sp. nov. Dorsal view of left antenna of brachypterous female.

E—*Haplothrips rosai* sp. nov. Dorsal view of right antenna of brachypterous female, with all setae omitted.

base. Vertex slightly depressed next to eyes; weakly convex dorsally and in front. Eyes large, between one quarter and one third as long as head and nearly one third as wide; dorsally the inner and hind margins forming a distinct obtuse angle; ventrally weakly, roundly produced at the inner caudal angle. Facets small and regular, about 7 occupying the outer outline of eye. Ocelli absent. A few minute setae around inner outline of eye and a few others on vertex, cheeks, and dorsum. Postocular setae about 1.3 as long as eyes and set about .3 the eye length from posterior margin, somewhat closer to the cheek. Mouth cone about .45 as long as head; evenly conical; rounded at end; labrum dark-tipped and just short of labial margin; maxillary palpi long and thick.

Antennae about twice as long as head; inter-antennal costa short, straight across end, only a fourth or fifth as wide as the basal antennal segments. Antennal segments as illustrated; segment 8 constricted at base and narrower than segment 7; segments 3, 4, 5, 6 each with a weak, blunt sense cone on either side; segment 7 with a longer, thinner cone dorsally. Porus on segment 2 conspicuous, about .115 mm. in diameter, placed near distal end of segment. Antennal hairs pale, rather weak.

Prothorax about .8 as long as head and not including coxae about 1.4 as wide; fore and hind margins weakly arched; sides weakly divergent to middle and thence parallel to posterior angles. All setae pointed; anteroangulars and midlaterals about equal to each other, and to coxals, about .5 as long as postoculars, epimerals and posteroangulars; anteromarginals minute. A short wavy median groove is generally apparent.

Pterothorax subquadrate, very slightly tapered caudally, about .205 mm. long on midventral line including first abdominal sternite, about .225 mm. across anterior angles. Wings reduced to short pads. Fore legs a little shorter and thicker than others; fore tarsi without tooth on inner surface, but all tarsi with usual claw on outer surface.

Abdomen long and heavy, widest on segments 4 and 5 which are about equal. Posteroangular setae greatly reduced, sometimes minute, on segments 1 to 7; about half as long as the segment on segment 8; about equal to the segment on segment 9. Terminals about 1.4 as long as tube. Tube somewhat less than twice as long as wide at base and about twice as wide at base as at end, tapering evenly from basal fifth to end and about .7 as long as head. Paired pori about .004 mm. in diameter, placed on about distal fourth.

Measurements of female holotype (brachypterous; treated with KOH) in mm.: Head length .164; head width across cheeks .143; eye length .053; prothorax length .139; prothorax width not including coxae .205; pterothorax length including first abdominal sternite .205; pterothorax width at anterior angles .225; abdomen width at segment 5, .315; tube length .110; tube width at base .061; tube width at end .032; postocular setae .041; anteroangular setae on prothorax .020; midlateral setae .016 (paratype); epimeral setae .041; posteroangular .041; coxal .020; posteroangular on abdominal segment 9, .065; median on abdominal segment 9, .077; terminals on tube .123 (approx.).

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.024	.045	.045	.041	.045	.045	.036	.028	.309

Brachypterous male: Smaller than female, only 1.07 mm. long; of same color and similar in general appearance but with prothorax and tube shorter in relation to head. Distinguished at once from the males of all other *Haplothrips* by a large, more or less reniform, granulose depression medianly located on the 8th ventrite.

Measurements of male allotype (brachypterous; treated with KOH) in mm.: Head length .139; head width .123; prothorax length .102; prothorax width .164; pterothorax length .143; pterothorax width (approx.) .205; abdomen width (segment 5) .217; tube length .082; tube width at base .049; tube width at end .028; postocular setae .041; anteroangulars on prothorax .024; epimerals .041; posteroangulars .041; posteroangulars on segment 9,

.036; medians on segment 9, .065; longest terminals (sides) on tube .123; coxals .016.

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.024	.036	.036	.036	.036	.041	.032	.028	.269

Described from the following material: One female paratype from *Metrosideros* leaves, Kilauea, April 14, 1944, N.L.H. Krauss, coll.; female holotype from dead branch of *Metrosideros*, Makao-puhi, H.N.P., 2,870 ft. elev., July 6, 1945, C.J.D., coll.; one female paratype from *Sadleria stipes*, Makaopuhi, H.N.P., 2,870 ft. elev., July 19, 1945, C.J.D., coll.; male paratype and allotype from leaves of *Vaccinium reticulatum*, H.N.P., March 14, 1945, C.J.D., coll.; one male paratype from dead branch of *Myrsine lessertiana*, Makaopuhi, H.N.P., 2,870 ft. elev., July 16, 1945, C.J.D., coll.

With the heavy abdomen and the caudally widened head, *rosai* does not have the habitus typical of most *Haplothrips* known to me, and perhaps under a more natural classification of the Tubulifera than we now possess the species would not fall into that genus. As it is diagnosed at present, however, the scope of *Haplothrips* does comprehend the whole combination of characters displayed by the new species, which no other genus will quite do.

The granulose depression is plain and fully developed in all male specimens and, to judge by appearances, must serve the same function as the elliptical depressions found on the sternites of many male Terebrantia. I cannot find in the literature any other mention of such an organ in the Tubulifera; but possibly it has been overlooked, as could easily happen in the case of the usual dorso-ventral mounts.

I dedicate this species to Mr. Joseph S. Rosa, who for many years has been my helpful colleague and valued friend.

#### **Haplothrips (Hindsiana) sakimurai** Moulton.

One female in dead twigs of *Myoporum sandwicense*, Mauna Loa truck trail, H.N.P., 4,200 ft. elev., July 17, 1945, C.J.D. and F.A.B., colls.

#### **Karnyothrips melaleuca** (Bagnall)

One female on dead stipes of *Cibotium chamissoi*, north of sulphur banks, H.N.P., 4,050 ft. elev., July 15, 1945, C.J.D., coll.; two females beaten off dead branches of *Heimerliodendron brunonianum* (Endl.) Skotts., Kipuka Puauulu, H.N.P., October 11, 1945, C.J.D., coll.; one female beaten off old branches of *Pittosporum convertiflorum* Gray, Pauahi Crater, H.N.P., October 22, 1945, C.J.D., coll.

#### **Karnyothrips flavipes** (Jones)

Three males in old branches of *Acacia koa*, Six Tanks, H.N.P., 4,600 ft. elev., November 1944, C.J.D., coll.; two females on dead branches of ohia lehua, Pauahi Crater, H.N.P., December 17, 1944,

C.J.D., coll.; six females on dead branches of *Mezoneurum kauaiense*, east of Puu Waawaa Ranch road, May 26, 1945, C.J.D., coll.; one female in dead twigs of *Myoporum sandwicense*, truck trail, H.N.P., July 17, 1945, C.J.D. and F.A.B., colls.; one female on *Macaranga*, Hilo, February 24, 1945, William C. Look, coll. (this is the specimen referred to as *Haplothrips* sp. by Sakimura in the Proc. Haw. Ent. Soc., vol. 12:331); two females on old branches of *Coprosma* sp., Ohaikea, 4,200 ft. elev., H.N.P., October 13, 1945, C.J.D., coll.; four females beaten off dead branches of *Myrsine sandwicensis* A. DC., Alealea Crater, H.N.P., October 30, 1945, C.J.D., coll.; four females beaten off dead branches of *Myrsine lessertiana* A. DC., Makaopuhi, November 18, 1945, C.J.D., coll.

**Karnyothrips dollicornis** sp. nov. (Plate XXX, figs. A, B, C)

Brachypterous female: Body length, partly distended, 1.44 mm. Color by transmitted light chestnut brown; middle of tube, tarsi, tibiae, particularly at base and apex, lighter; antennal segments 2, 3, sometimes also base of 4, pale yellowish brown; ocellar crescents, sub-hypodermal pigment red. Striation fine, visible only in cleared specimens, transversely subreticulate on head and mesoscutum, longitudinally reticulate on sides of metanotum.

Head about 1.25 as long as wide; the sides almost straight and parallel from the eyes to about basal fourth, thence weakly and roundly constricted to base; vertex weakly concave next to eyes and weakly convex in middle. Each eye occupying a little less than a quarter head length and a little more than a quarter of head width; the inner dorsal outline irregularly rounded and the inner ventral outline forming an almost right angle; the outer contour protruding very slightly from the vertex and not at all from the cheek; the dorsal facets of same diameter as ocelli and the ventral facets somewhat larger. Ocelli widely separated but not touching inner margins of eyes; the anterior ocellus forwardly directed on declivity of vertex. Postocular spines about .2 longer than eyes, set nearly one third of the eye's length from its margin and about an equal distance from the cheek. One minute spine in front of each posterior ocellus and two on a longitudinal line behind; other very minute spines scattered over dorsum and sides of head. Mouth cone slightly less than half as long as rest of head, much narrower than head at base, broadly rounded at end; labrum blacktipped and not surpassing labium.

Antennae about twice as long as head, inserted a little caudad of vertex; the frontal costa less than half as wide as basal antennal segments, slightly projecting and weakly concave. Antennal segments as illustrated; 3 widened basally at right angles to the pedicel and more or less barrel-shaped above pedicel; 7 not pedicellate and broadly joined to 8. Sense cones weak, only a third or fourth as long as segments bearing them, tapering distally but not sharply pointed; two more or less lateral cones on segments 3 to 6 and one, longer and thinner than the others, on segment 7. Porus on segment 2 conspicuous, about .006 mm. in diameter. Antennal hairs pale, weak, inconspicuous.

Prothorax about .75 as long as head and not including coxae about .6 wider basally than head; the fore and hind margins only weakly arched; the sides more strongly divergent from anterior angles to middle than from middle to posterior angles. Median suture short, wavy. Excepting anterior marginals, all the usual major setae present; all, including prominent coxals, expanded apically, pale, sub-equal in length. Minor setae very small and inconspicuous. Pterothorax normal, about as wide as prothorax at prominent anterior angles and tapering slightly caudally, about .217 mm. long on the

midventral line. Legs rather short and stocky; fore femora slightly incrassate and fore tarsi inconspicuously armed on the basal segment with the usual outer claw and a small inner tooth which sometimes does not surpass the tarsal outline.

Abdomen long and heavy, nearly twice as long as rest of body, widening very gradually to segment seven, thence abruptly narrowed to base of tube. All major setae capitate excepting terminals on tube and laterals on segments 7 and 9. Tube twice as wide at base as at end and nearly twice as long as wide at base, considerably shorter than width of head; the sides parallel on basal fifth (inserted in segment 9) and thence evenly convergent; paired pori on sides of distal fifth; six long terminal setae little less than twice as long as tube.

Measurements of type (apterous female treated with caustic potash) in mm.:

Antennal segments:	1	2	3	4	5	6	7	8	Total
	.041	.045	.036	.045	.045	.036	.053	.032	.333

Body length 1.2; head length .17; head width across cheeks .13; eye length .045; eye width .032; prothorax length .123; prothorax width, including coxae, .254; pterothorax length on mid-dorsal line .184; pterothorax width on anterior angles .246; width of abdomen on segment 6, .266; tube length .106; tube width at base .061; tube width at end .028; postocular setae .049; anteroangulars .041; midlaterals .041; epimerals .049; posteroangulars .041; coxals .041; pointed laterals on segment 7, .102; pointed laterals on segment 9, .135; longest terminals on tube (laterals) .205 (approx.); proximal sub-basal on forewing .032; distal sub-basals on forewing .136.

Macropterous female: Similar to brachypterous form except in the possession of wings and large sigmoid setae paired on abdominal tergites 3 to 7. The forewings are clearly narrowed in the middle and faintly smoky, with the smokiness disappearing near the end. They possess 4 intercallary ciliae, and 3 capitate sub-basals of which the proximal is a trifle shorter than the other pair and the middle one is inserted slightly inward from the others.

Described from the following material, all collected by Mr. Davis: two brachypterous females from dead branches of *Metrosideros*, Makaopuhi, H.N.P., 2,870 ft. elev., July 6, 1945, type and paratype No. 1; one brachypterous female on living branch of *Metrosideros*, Puhinau Crater, H.N.P., October 12, 1944; one brachypterous female on living branch of *Sophora chrysophylla*, near Kipuka Ki, H.N.P., 4,500 ft. elev., December, 1944; one brachypterous female on *Sadleria stipes*, near Makaopuhi, H.N.P., 2,860 ft. elev., December, 1944, paratype No. 2; one macropterous female, host unrecorded, H.N.P., December 12, 1944, paratype No. 3.

In addition to the type series, I have two brachypterous females collected by Davis on *Myoporum sandwicense*, dead wood, at Keauhou Ranch, 4,200 ft. elev., July 23, 1945, and two brachypterous females beaten off dead branches of *Myrsine lessertiana* at Makaopuhi, H.N.P., on November 18, 1945.

The habitus of this new species is typical of the genus and it might be mistaken in Hawaii for *Karyothrips flavipes* (Jones) if it were not for the very distinctive antennae and the inner tooth of the fore tarsus, which is much shorter in *doliicornis* and sometimes hardly surpasses the contour of the tarsus. To judge by the illus-



trated description, *Zygothrips pallidus* Hood has very similar antennae, but in other respects the two species are quite different.

**Hoplothrips swezeyi** Moulton

One male under bark of *Metrosideros*, Hiiaka Crater, H.N.P., December 17, 1944, C.J.D., coll.

**Phloeothrips mauliensis** Moulton

One male and two females on old branches of *Sophora chrysophylla*, Kipuka Ki, H.N.P., December 17, 1944, C.J.D., coll.; one female on old branch of *Pittosporum convertiflorum* Gray, Pauahi Crater, H.N.P., October 22, 1945, C.J.D., coll.

**Macrophthalthrips hawaiiensis** Moulton

Four females in old branches of *Sophora chrysophylla*, Kipuka Ki, H.N.P., 4,500 ft. elev., November 6, 1944, C.J.D., coll.; two males and one female in old branches of *Acacia koa* near Six Tanks, H.N.P., November, 1944, C.J.D., coll.; one male and one female under bark of *Sapindus saponaria* Linn., H.N.P., January 31, 1945, C.J.D., coll.; one female in old branches of *Acacia koa*, H.N.P., February 10, 1945, C.J.D., coll.; one female on old branch of *Xylosma hawaiiensis* Seem. var. *hillebrandii* (Wawra) Sleumer, Kipuka Puau, H.N.P., October 11, 1945, C.J.D., coll.; one male beaten off dead branches of *Perottetia sandwicensis* Gray, N.W. of Keauhou Ranch, October 19, 1945, C.J.D., coll.

**Podothrips lucasseni** (Kruger)

Many males and females on sugar cane, Honokaa, October 15, 1924, C. E. Pemberton, coll.

TEREBRANTIA

**Chirothrips mexicanus** Crawford

Five females by sweeping grass, Six Tanks, H.N.P., January 1, 1945, C.J.D., coll.

**Chirothrips fulvus** Moulton

One female beaten off dead leaves of *Styphelia tameiameia*, end of Mauna Loa truck trail, 6,500 ft. elev., H.N.P., October 12, 1945, C.J.D., coll.

**Hercothrips fasciatus** (Pergande)

Abundant on leaves and stems of *Argemone glauca* and of *Sonchus oleraceus*, near Naalehu, June 5, 1945, F.A.B., coll.

**Hercinothrips femoralis** (Reuter)

One female on grass, Six Tanks, H.N.P., January 31, 1944, C.J.D., coll.

**Scirtothrips antennatus** Moulton

Small colony, females and young, on leaves of *Plumeria*, Hono-

kaa, March 29, 1944, F.A.B., coll.; small colony on leaves of *Columbrina oppositifolia* Brongn., Puu Waawaa, 1,900 ft. elev., C.J.D., coll.

**Anaphothrips swezeyi** Moulton

Abundant on sugar cane and grass, Honokaa, October 19, 1924, C. E. Pemberton, coll.

**Thrips saccharoni** Moulton

Abundant on sugar cane, Honokaa, February 26, 1923, C. E. Pemberton, coll.

**Merothrips morgani** Hood (Proc. Ent. Soc. Wash., 14: 132, 1912)

One female beaten off dead branch of *Santalum paniculatum* Hook. & Arn., Kipuka Puau, H.N.P., October 11, 1945; five females and one male beaten off dead branches of *Heimerliodendron brunonianum* (Endl.) Skottsb., same date and locality as above; one female beaten off branches of *Urera sandwicensis* Weddell, same date and locality as above; two females and one male beaten off dead branches of *Perottetia sandwicensis* Gray, 1¼ miles N.W. of Keauhou Ranch, October 19, 1945; two females and one male beaten off dead branches of *Pittosporum convertiflorum* Gray, Pauahi Crater, H.N.P., October 22, 1945; all collected by Mr. Davis.

Perfect agreement of all these specimens with Hood's careful, illustrated description leaves no doubt of their identity. This wingless species was described from Illinois and Kentucky and its discovery in Hawaii, constituting a new record for the Territory, suggests that the species is probably more abundant and of wider range on the American continent than is shown by published records. It is improbable that such a species could have reached Hawaii from the eastern United States without also spreading its range to the west coast.

Comparison of Mr. Davis' specimens with a paratype of the winged *Merothrips hawaiiensis* Moulton (Proc. Haw. Ent. Soc., 9 [3]: 411, 1937) borrowed from the collection of the Pineapple Research Institute, Honolulu, shows a very close resemblance of the two species and indicates that they may be but the winged and the wingless forms of a single species. Until the two forms are collected together, however, or at least on the same island, their synonymy will remain doubtful.

**Thrips (Isoneurothrips) australis** Bagnall

One female from a flower of *Pittosporum undulatum* Vent., residential area, H.N.P., March 14, 1945, C.J.D., coll.

**Thrips (Isoneurothrips) carteri** Moulton

End of Mauna Loa truck trail and Kipuka Ki, H.N.P., at elevation of 6,400 and 4,200 ft. respectively, on several dates, C.J.D. and F.A.B., colls.

In contrast to other *Isoneurothrips*, which are mostly collected in flowers, colonies of this species are often found associated with a rust fungus very common on *Acacia koa*. The relationship of the two organisms has not been worked out, but cursory observations indicate that the thrips probably lay their eggs among the massed spores of the fungus—"the rust"—and that the larvae feed on some exudation either of the fungus or of the host plant.

**Thrips (*Microcephalothrips*) *abdominalis* Crawford**

Numerous on flowers of *Erigeron*, near Kiholo, July 7, 1945, F.A.B., coll.

**Taeniothrips *gracilis* Moulton**

Abundant in all stages and feeding heavily on leaves and stems of *Crinum* sp., Pololu Valley, June 28, 1944, F.A.B., coll.

I have found this species hidden within the unopened flowers of the same host plant at Halawa Valley, Molokai, where the thrips were apparently not numerous enough to hurt the plant. Heavy injury is accompanied by extensive reddish discoloration of the plant.

**Taeniothrips *frici* (Uzel)**

Numerous on flowers of *Hypochoeris radicata* Linn., Mauna Loa truck trail, H.N.P., February 25, 1945; one female on dead branch of *Acacia koa*, same locality, August 8, 1945; two females beaten off dead leaves of *Styphelia tameiameia* (Cham.) F. Muell., same locality, October 12, 1945; all collected by Mr. Davis.

**Taeniothrips *cyperaceae* Bianchi**

One female on leaves of *Vinca major* L., residential area, H.N.P., March 11, 1945, C.J.D., coll.

**Frankliniella near *sulphurea* Schmutz**

This is the species which was first found during August of 1942 and which has since become a predominant species on Oahu. I presume it is the same species listed by Sakimura as "*Frankliniella* sp." from the island of Hawaii (Proc. Haw. Ent. Soc., 12[2]: 329) but I cannot find a more specific reference to its presence on that island. For the sake of an unmistakable record, therefore, I note here that the species is found on Hawaii and that it is quite common on the lowlands, although it does not appear to have attained the predominant position it has on Oahu. Mr. Davis collected the species from flowers of *Lantana*, *Hibiscus*, and monkeypod at Keauhou, Kona, during May of 1945, and I had previously found it on other hosts in two localities of the island, both under 2,000 ft. elevation.

**Host Records of *Philaenus spumarius* (Linn.) at Kilauea,  
Hawaii National Park  
(Homoptera: Cercopidae)**

By C. J. DAVIS and A. L. MITCHELL

(Presented at the meeting of August 13, 1945)

The family Cercopidae is represented in Hawaii by the single immigrant species *Philaenus spumarius* (Linn.). This spittle-insect was first seen in the islands by Warren Goolsby, who collected it from daikon (*Raphanus sativus* Linn. *longipinnatus* Bailey) and satsuma orange leaves near the Volcano House, Kilauea, Hawaii, on January 17, 1944 (Proc. Haw. Ent. Soc., 12: 219, 1945; as *P. leucophthalmus* [Linn.]). Herbert Osborn (Meadow and Pasture Insects: 101, 1939) states that *P. spumarius* "is a very widely distributed species both in Europe and America, and in the United States and Canada occupies a large area from the Atlantic coast to the plains regions." It probably reached Hawaii from the mainland of the United States on imported plant material in recent years. The present authors have observed it abundantly in Kipuka Puauulu (Bird Park), the administrative and residential area, Kipuka Ki, at the Hilo entrance to the park, and at the Kilauea Ranger Station (29 miles).

Nymphs immersed in froth have been commonly found on leaves and stems of a large number of different plants, though no injury to the infested plants has been observed. The adults are often found on vegetation near the infested foliage, or on the same plants occupied by the nymphs. A record has been kept of all plants on which the authors have observed froth masses. This is given below.

We are grateful to Dr. O. H. Swezey for identifying the insect and to Mr. C. E. Pemberton for encouragement and suggestions.

HOST	LOCATION	DATE
<i>Saccolipsis contracta</i>	Nursery	Jan. 30, 1945
<i>Centaureum umbellatum</i>	Nursery	Jan. 30
<i>Ilex anomala</i> §	Crater Rim Road	Jan. 30
<i>Hibiscus tiliaceus</i> §	Nursery	Jan. 30
<i>Hypochoeris radicata</i>	Hilo entrance	April 3
<i>Rubus penetrans</i> *†	Hilo entrance	April 3
<i>Digitaria pruriens</i>	Hilo entrance	April 3
<i>Trifolium procumbens</i>	Hilo entrance	April 3
<i>Plantago lanceolata</i>	Hilo entrance	April 3
<i>Geranium carolinianum</i> var. <i>australe</i> *†	Hilo entrance	April 3
<i>Verbena litoralis</i> †	Hilo entrance	April 3
<i>Mentha</i> sp.†	Kipuka Puauulu	April 3

\* Previously recorded by N. L. H. Krauss (Proc. Haw. Ent. Soc., 12:220, 1945).

† Preferred host.

§ Indigenous host.

HOST	LOCATION	DATE
<i>Brassica oleracea</i> var. <i>botrytis</i>	Quarters 22	April 17
<i>Lactuca sativa</i>	Quarters 22	April 17
<i>Medicago hispida</i>	Quarters 31	May 11
<i>Mesembryanthemum</i> sp.*	Quarters 31	May 11
<i>Senecio mikanoides</i>	Quarters 31	May 11
<i>Tibouchina semidecandra</i>	Quarters 31	May 11
<i>Gnaphalium purpureum</i>	Quarters 31	May 11
<i>Dianthus chinensis</i>	Quarters 31	May 11
<i>Coprosma rhynchocharpa</i> *§	Kipuka Puaulu	May 15
<i>Veronica plebeia</i>	Kipuka Puaulu	May 15
<i>Modiola caroliniana</i>	Kipuka Puaulu	May 15
<i>Commelina diffusa</i>	Kilauea ranger sta.	May 17
<i>Chrysanthemum maximum</i>	Kilauea ranger sta.	May 17
<i>Vinca</i> sp.	Kilauea ranger sta.	May 17
<i>Panicum purpurascens</i>	Kilauea ranger sta.	May 17
<i>Sonchus oleraceus</i>	Kilauea ranger sta.	May 17
<i>Tritonia crocosmaeflora</i>	Kilauea ranger sta.	May 17
<i>Erigeron albidus</i>	Headquarters bldg.	May 18
<i>Oenothera striata</i>	Observatory	May 18
<i>Cordyline terminalis</i>	Quarters 20	May 19
<i>Myosotis azorica</i>	Quarters 7	May 20
<i>Cyperus brevifolius</i>	Quarters 7	May 20
<i>Cynodon dactylon</i>	Quarters 7	May 20
<i>Hebe salicifolia</i>	Quarters 7	May 20
<i>Anagallis arvensis</i>	Kipuka Puaulu	May 21
<i>Dactylis glomerata</i>	Kipuka Ki	May 26
<i>Rheum rhaponticum</i>	Quarters 21	May 27
<i>Holcus lanatus</i>	Kipuka Puaulu	May 31
<i>Lythrum maritimum</i>	Residential area	June 11
<i>Fuchsia magellanica</i> *	29 Miles	June 11
<i>Wikstroemia phillyreaefolia</i> §	Nursery	June 13
<i>Raillardia scabra</i> §	Nursery	June 13
<i>Coprosma ernodeoides</i> var. <i>typica</i> §	Nursery	June 13
<i>Artemisia vulgaris</i>	Adm. area	June 29
<i>Dahlia</i> sp.	Quarters 22	July 2
<i>Hypericum moserianum</i>	Quarters 2	July 4
<i>Pastinaca sativa</i>	CCC camp	July 11
<i>Coix lacryma-jobi</i>	CCC camp	July 11
<i>Solidago altissima</i>	Residential area	Sept. 1
<i>Physalis peruviana</i> *	CCC camp	Oct. 9
<i>Bidens pilosa</i> var. <i>minor</i>	Quarters 22	Oct. 13
<i>Rumex acetosella</i>	Quarters 22	Oct. 13
<i>Daucus carota</i> var. <i>sativa</i>	Quarters 21	Oct. 23
<i>Ipomoea batatas</i>	Quarters 22	Nov. 1
<i>Pluchea odorata</i>	CCC camp	Dec. 31
<i>Metrosideros collina</i> var. <i>polymorpha</i> §	Nursery	Jan. 10, 1946

\* Previously recorded by N. L. H. Krauss (Proc. Haw. Ent. Soc., 12:220, 1945).

§ Indigenous host.

# On the Species of *Araecerus* Schoenherr, 1823, Known from the Hawaiian Islands

(Coleoptera: Anthribidae)

By H. E. KARL JORDAN, Ph.D., F.R.S.

Zoological Museum, Tring

(Presented at the meeting of November 19, 1945)

The present account of the Hawaiian *Araecerus* is based on some 180 specimens, of which 110 have been entrusted to me for determination by the Bernice P. Bishop Museum, the others (mostly collected by Blackburn and Perkins) being the property of the British Museum (Natural History). This material was obtained on the six main islands: Hawaii, Maui, Lanai, Molokai, Oahu and Kauai. The genus, however, may be expected to occur also on some of the small outlying islands, such as Laysan, which have some vegetation.

*Araecerus* is an Old World genus, numerous in species, most of which are Oriental, only a few being known from the Aethiopian region. On the American continents only one species is found, *A. fasciculatus*, which has become cosmopolitan with the trade in coffee beans. This name was applied by Blackburn and Sharp (in 1885) to all the specimens which Blackburn had found on the Hawaiian Islands, and in 1900 Perkins followed their example, adding to the fauna a conspicuous new species he had discovered on Hawaii. In reality, the specimens considered to be *A. fasciculatus* represented three species, as is proved by the Blackburn and Perkins material before me. The oversight on the part of these authors is readily excused: at that time the descriptions of species of *Araecerus*, with some exceptions, were very superficial, the trenchant distinctions not being known. The specific differences in structure are mainly found on the under side, and as the specimens in collections are generally so mounted that the under side is concealed, it is not to be wondered at that these differences escaped notice. Errors in the determination of *Araecerus* are in consequence of frequent occurrence. For instance, I have had in the collection at Tring for many years a species as *Araecerus koebelei* Blackburn, 1900, which is not *koebelei* at all, as I saw at a glance when the transfer of the British Museum Anthribidae to Tring for amalgamation with my collection (presented to the British Museum) gave me an opportunity to turn the type of *A. koebelei* over

and look at its under side. A similar mistake caused by the inconvenient mounting of the specimens was made by O. H. Swezey, who, in 1934, recognized *A. vieillardii* Montrouzier, 1860, as a third species among the Hawaiian *Araecerus*, but accepting the determination, by previous authors and himself, of the commonest species as *A. fasciculatus*, was misled by great superficial similarity to regard as *A. vieillardii* a series of specimens of which some were *vieillardii* and others were true *A. fasciculatus*.

The Hawaiian *Araecerus* before me represent four species: two being indigenous and not known from elsewhere (*A. constans* Perkins, 1900, evidently a rarity and almost constant in coloring, and a new species, very variable and distributed over the archipelago), and two accidentally introduced (*A. fasciculatus* [Degeer 1775], cosmopolitan, and *A. vieillardii* [Montrouzier 1860] from the islands of the Pacific, exact westward distribution not yet known).

In consequence of the misidentifications referred to above, the records of habits and other biological details have lost most of their value. New observations are necessary. I have compared the records in the Proceedings of the Hawaiian Entomological Society with the labels on the specimens and found out in some instances to which particular species the published note applies. Perhaps Mr. E. C. Zimmermann will be successful in obtaining the original specimens on which the biological records were based. Two of the four Hawaiian *Araecerus* are common and easy to breed, and there is a great opportunity to study the larvae and discover specific differences in their morphology and perhaps their habits which would be of much value.

The majority of species of *Araecerus* are more easily recognized by the males. Determination, therefore, should generally be based on the male. In all true *Araecerus* the sexes are distinguished from each other by the last external segment: its tergum (pygidium) is more or less vertical in the male, with the apex rounded, and the sternum about as long medianly as the previous one; the antenna is somewhat longer, the fore tibia and fore tarsus are long-hairy beneath and prolonged, the tibia bearing, in three of the Hawaiian species, prominent tubercles on the underside, and in one (*A. vieillardii*), an apical mucro in addition. In the female the pygidium is longer, triangular, with the margin of the tip somewhat curved up, the last external sternum being much longer medianly than the preceding segment; in many females the ovipositor projects more or less from the anal segment; the foreleg, though longer than the midleg, is not long-hairy beneath and bears no tubercles in the female of any species. The organs of reproduction are not referred to here; their differences will be better understood in a survey of the whole genus.

## KEY TO THE HAWAIIAN SPECIES

## A. Males

- a. Fore tibia with apical mucro on under side.....*vieillardii* (Montrouzier).  
Fore tibia without apical mucro..... b
- b. Fore tibia without prominent tubercles on under side; midcoxa without a tubercle.....*fasciculatus* (Degeer).  
Fore tibia with tubercles on under side from near base to apex..... c
- c. Coloring of upper side very variable, subbasal swelling of elytra distinct; tibiae more or less blackish on upper side in middle.....  
.....*varians*, new species.  
Almost uniformly grey on upper side, subbasal swelling of elytra less distinct, the insect more evenly convex in lateral aspect, broader and larger than *A. varians*, tibiae uniform in color, or darkened at apex.....*constans* Perkins.

## B. Females

- a. Prosternum centrally rough with large punctures and tubercles.....  
.....*vieillardii* (Montrouzier).  
Central area of prosternum without large punctures, at most with small ones along anterior margin..... b
- b. Tibiae with four blackish (or brown) spots: basal, antemedian, postmedian and apical; sculpture of pronotum and elytra as coarse as in *A. vieillardii*.....*fasciculatus* (Degeer).  
Tibiae without dark spots, or without basal spot and with the ante- and postmedian spots confluent; sculpture of upper side less coarse ..... c
- c. Subbasal swelling of elytra very distinct in lateral aspect, pronotum and elytra from behind subbasal swelling to near apex less convex than in the two preceding species, tibiae with large blackish median spot on upper side, first and second abdominal segments with fewer than five rows of punctures each side and the median rows sublaterally missing; color as in male.....*varians*, new species.  
Larger and broader, subbasal swelling of elytra less distinct, tibiae not spotted, abdominal sternum I with five irregular rows of large punctures from side margin, II and IV with six to eight, sublaterally no large space devoid of punctures; upperside colored as in male.....*constans* Perkins.

1. *Areocerus constans* Perkins

*Areocerus constans* Perkins, Fauna Hawaiiensis 2 (3) : 182, 1900  
(Hawaii: Kona, in flowers of white poppy).

*Areocerus constans* Perkins, Zimmerman, Proc. Hawaiian Ent. Soc. 10: 152, 1938 (key to Hawaiian Anthribidae).

Larger than the other Hawaiian *Areocerus*, pronotum and elytra together twice as long as broad, sculpture of upper surface less coarse than in *A. fasciculatus*, pubescence uniformly grey, with indications of grey spots on the elytra. Club of antenna less unsymmetrical than in *A. fasciculatus*, the proportional length (in male) of the three segments: IX 27, X 24, XI 30, width 14. Lateral angle of pronotal carina a little more than 90°, the lateral carina slightly more slanting than in *A. fasciculatus*. Subbasal swelling of elytra less elevate than in *A. varians*, the upper surface being more evenly convex in lateral aspect. Central antecoxal area of prosternum somewhat uneven with low swellings and small punctures and tubercles; midcoxa of male with a low transverse tubercle. Punctures at side of abdomen more



numerous than in the three other species. Tibiae rufescent or dark brown (discolored ?), without dark spots, fore tibia of male with distinct tubercles on inner side. Length 4.2 to 5 mm.

One male examined from Bishop Museum [plus four examples not seen by Jordan, E. C. Z.]. In British Museum three males and five females, original specimens collected by Perkins; the species does not seem to have been met with again. A card bearing a male and a female is marked "type". I select the male as the type. The card bears a crossed-out name which is preoccupied in *Araecerus*; mentioning the name would create an unnecessary synonym of *A. constans*. [Some of the Bishop Museum set also bear this name, E. C. Z.]

## 2. *Araecerus varians*, new species (fig. 1, A)

*Curculio fasciculatus* Degeer, Blackburn and Sharp, Trans. Royal Dublin Soc. (2) 3: 195, 1885 (Hawaii, Maui, Lanai, Oahu, Kauai; has no saltatory power whatever; partim).

*Araecerus fasciculatus* (Degeer), Perkins, Fauna Hawaiiensis 2 (3): 182, 1900 (partim).

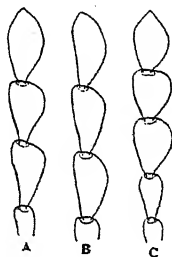


Figure 1.—Outlines of terminal segments of antennae of the males of three species of *Araecerus*.—A. *A. varians*, new species; B. *A. fasciculatus* (Degeer); C. *A. vieillardii* (Montrouzier). Hairs and bristles omitted.

Closely agreeing with *A. constans* in structure. Smaller, but the largest individuals attaining the length of the smallest example of *A. constans* known to me. Subbasal swelling of elytra much more raised, the elytra, in lateral aspect, therefore, from this point backwards more slanting and flatter than in the other Hawaiian species, the swelling more glossy; disk of pronotum more flattened, angle of carina as in *A. constans*, lateral carina straighter; club of antenna a little broader than in *A. constans*, proportions in males 30, 24, 27, width 14. Central antecoxal area of prosternum nearly as smooth as in *A. fasciculatus*, with some small tubercles in front of coxae; abdominal sterna with fewer punctures than in *A. constans*, segment I bearing only four rows at sidemargin and the median rows disappearing about halfway between side-margin and trochanter, leaving a fairly large area devoid of punctures except at margins; tibiae of well-preserved mature specimens with a large, diffuse dark median patch on upper side. In male the fore tibia with two rows of tubercles on inner surface (not very prominent in small males), no apical mucro; midcoxa with a low transverse tubercle or ridge. Pubescence of upper side very variable in color, the varieties connected by intergradations: elytra brown variegated and dotted with grey, somewhat as in *A. fasciculatus*,

but the alternate interspaces not contrasting as in that species,—or elytra grey with three transverse brown bands or patches,—or elytra brown with a grey lateral stripe from base to apex,—or elytra brown mottled with grey and bearing a grey sutural stripe,—or upper side grey with the side of the pronotum and a lateral well-defined patch on the elytron brown. Length 2.8-4.2 mm. (pronotum and elytra together).

Type in British Museum, from Maui: Iao Valley, March, 1894 (Perkins), a male with grey dots on elytra. 103 specimens examined (paratypes).

Hawaii: South Kona, November, on *Clermontia* (Swezey coll.); Kilauea, July, and Kona, June, July and September (Perkins coll.).

Maui: Kailua, June, on *Elaphoglossum* and *Straussia*, Halehaku, June, and Wailunanui, July (Bryan coll.); Haleakala, 3-4000 ft., March and April, 5000 ft., March and May (Perkins coll.).

Molokai: Kalae, August (Perkins coll.); Kalihuki, 3800 ft., August, on Hilo grass (C. M. Cooke, Jr., coll.).

Lanai: 2000 ft., December and January, and Halepaakai, July (Perkins coll.).

Oahu: Near Honolulu, May; Waianae Mts., April, 2-3000 ft., Nuuanu Valley, November (Perkins coll.); Kaumuaahona, June (Bridwell coll.); S. Waianae Mts., November (Swezey coll.).

Kauai: Kaholuamano, 4000 ft., Halemanu, 4000 ft., May, and high plateau, August (Perkins coll.); Kumuwela, on *Cyanea* and *Pipturus*, August (Swezey coll.).

### 3. *Araecerus fasciculatus* (Degeer) (fig. 1, B)

*Curculio fasciculatus* Degeer, Mem. Hist. Nat. Ins. 5: 276, pl. 16, fig. 2, 1775.

*Araecerus* (*Curculio*) *fasciculatus* Degeer, Lucas, Ann. Soc. Ent. France, (4) 1: 404, 1861 (partim; synonymy, *fasciculatus* for the first time identified with *cacao* and *coffae* of Fabricius).

*Araecerus fasciculatus* (Degeer), Swezey and Bryan, Proc. Hawaiian Ent. Soc. 7: 299, 1929 (Molokai: in husk of kukui nut [*Aleurites moluccana*], partim).

*Araecerus vieillardii* (Montrouzier), Swezey ibid., 9: 17, 1934 (partim).

In both introduced species the net-like sculpture of the pronotum and the granulation of the elytra are coarser than in the two indigenous ones, the elytra are more cylindrical and the sides of the pronotum more swollen; tibiae quadrimaculate. Size variable, but coloring of upper side nearly constant in the Hawaiian Islands, russet brown, clouded and spotted with grey pubescence.

In *A. fasciculatus* head and rostrum grey, with some brown markings shining through: on rostrum a subapical transverse band medianly enlarged backwards, on frons each side a patch separate from eye, on occiput a pair of smaller patches nearer together, in many specimens these markings diffuse or are obsolescent; apical area of pronotum grey, usually with a marginal brown spot each side of a grey median dash, rest of pronotum suffused with

grey, in some specimens with the spots more distinct; on elytra a distinct but ill-defined grey patch above shoulder and another at apex, and in many individuals a short grey sutural stripe behind scutellum, alternate interspaces somewhat contrasting in an aspect from front, III, V, VII and IX being feebly convex and bearing each 5 to 7 grey spots. Club of antenna unsymmetrical, more so in male than in female, proportions of IX-XI: 30, 27, 27, width 13. Central antecoxal area of prosternum smooth, at most with some small punctures at anterior margin. Puncturation of abdomen essentially as in *A. varians*. Midcoxa of male without tubercles and anterior tibia without rows of tubercles present in the other three species, no apical mucro. Length (pronotum and elytra together) 2.3 to 4 mm., but more dwarfed specimens may be expected to occur (as elsewhere).

Forty-seven specimens, all but three in Bishop Museum:

Maui: Iao Valley, December, on coffee tree (Bryan coll.).

Molokai: Kainalu, July, kukui nut and *Cassia occidentalis* (Bryan coll.).

Oahu: Honolulu (Hawaii Agric. Exper. Station), star apple, April, University of Hawaii farm, October, Bishop Museum, June, Honolulu, February, Kawailoa, June, Waialae Iki, November, Oahu Plantation, Waipio, September, Ewa coral plain, on *Morinda*, December (Bryan coll.); Honolulu, no date, Palolo, February (Illingworth coll.); Honolulu, in algaroba seeds, April (Perkins coll.); Keakakei Valley, on a lobelioid, June, (Adamson coll.); Palolo, ex koa, January (Young coll.); Mokuleia, on breadfruit, March, (Wilder coll.); Manoa, February, and Honolulu, October (Ball coll.); Tantalus, no date, no collector.

Kauai: Ahukini, sugar cane, July, and Lihue, ex sun flower, August (Bryan coll.).

In British Museum 3 specimens collected by Blackburn, one of them labelled Oahu.

Whereas Blackburn emphatically states that what he identified as *A. fasciculatus* has no saltatory power, observers in other parts of the world report that *A. fasciculatus* is very lively and makes jumps 2-3 cm. high and 4 cm. wide. Perhaps *A. varians* does not jump, which would be an interesting distinction.

#### 4. *Araecerus vieillardii* (Montrouzier) (fig. 1, C)

*Curculio vieillardii* Montrouzier, Ann. Soc. Ent. France (3) 8: 873, 1860 (New Caledonia; footnote: "Genre *Araecerus*").

*Araecerus fasciculatus* (Degeer), Swezey and Bryan, Proc. Hawaiian Ent. Soc. 7: 299, 1929 (Molokai, in husks of kukui nut; partim).

*Araecerus vieillardii* (Montrouzier), Swezey, ibid, 9: 17, 1934 (specimens in collection Hawaiian Sugar Planters'; partim, some being *A. fasciculatus*).

In general appearance and the coarse sculpture of pronotum and elytra resembling *A. fasciculatus* so much that the two species are easily mixed up. It is fairly easy, however, to distinguish one from the other by a comparison

of the antennae, the forelegs and the underside of the thorax. Club of antenna shorter, the segments almost symmetrical, proportional length in male 25, 20, 22, width 15 (measurements varying in all four species); central antecoxal area of prosternum uneven, with tubercles and some large punctures; in male the midcoxa with a distinct conical tubercle and the fore tibia on innerside with an apical mucro and two rows of tubercles, which are readily visible in a lateral view of the tibia.

In the Bishop Museum material examined are 13 specimens; in British Museum 6, of which 5 collected by Blackburn are left without indication of the island and one (Perkins coll.) was obtained on Oahu.

Molokai: Kainalu, kukui nut, and at sea level, July (Bryan coll.).

Oahu: Koko Head, no date (Illingworth coll.); Rooke Valley, November (Swezey coll.); Kawaihoa, June, and Honolulu, August (Bryan coll.); Nuuanu Valley, May (Perkins coll.).

Kauai: Haena, August, Lihue, September, and Summit camp, September (Swezey coll.); Honopu, June (Bryan coll.).

The original home of *A. fasciculatus* was India or Africa, whereas *A. vieillardii* is essentially an inhabitant of the Pacific. There might be an opportunity for a Japanese species (described by Sharp in 1891 as *A. tarsalis*, a species found among beans by Lewis) to invade the Hawaiian Islands. This species is similar to *A. vieillardii*, but is darker, generally more regularly maculate on the elytra, segments IV and V of the antenna are together but little longer than III, the angle of the pronotal carina is smaller (more acute), the tarsi are broader, particularly in the male, the fore tibia of the male has no mucro, etc.

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Records of *Araecerus* in the Proceedings of the Hawaiian Entomological Society:

*Araecerus fasciculatus*, Giffard 1:181, 1908 (Lanai, beaten from kukui).

*Araecerus fasciculatus*, Bridwell 4:22, 1919 (imago of hymenopter on *Perisierola emigrata* eating larva).

*Araecerus fasciculatus* (!), Bridwell, loc. cit.: 407 (near Pearl City, pods of *Samanea saman* attached).

*Araecerus fasciculatus*, Swezey, ibid.: 452, 1921 (Sugar Loaf Hill and Waianae Mts., description of eggs found in koa pods, probably this species, but see also note below).

*Araecerus fasciculatus*, Swezey 5:15, 1922 (one specimen bred from *Sicana odorifera*).

*Araecerus fasciculatus*, Swezey loc. cit.: 187, 1923 (eggs described in 1921 not this species).

- Areocerus* (!) *fasciculatus*, Swezey 6: 233, 1923 (one specimen bred from rotten branches of *Plumeria*).
- Araecerus fasciculatus*, Swezey and Bryan, loc. cit. : 417, 1927 (Molokai, one at Kamiloloa).
- Araecerus fasciculatus*, Illingworth, 7: 44, 1928 (Lanai).
- Araecerus fasciculatus*, Illingworth loc. cit. : 250, 1929 (Kona, Hawaii, in and about cotton bolls).
- Araecerus fasciculatus*, Swezey and Bryan *ibid.* : 299, 1929 (Molokai, 11 at sea level to 100 ft., husks of kukui nut, etc.; 1 at Kamiloloa [Adamson]).
- Araecerus fasciculatus*, Illingworth, *ibid.* : 409, 1931 (Waipio, in water of Waiahole ditch).
- Araecerus fasciculatus*, Swezey *ibid.* : 498, 1931 (Maui, on *Cheirodendron gaudichaudii*).
- Araecerus vieillardii*, Swezey, 9: 17, 1935 (among *A. fasciculatus* in H.S.P.A. collection, list of localities).
- Araecerus vieillardii*, *id.*, loc. cit. (misprint).
- Araecerus fasciculatus*, Swezey, 9: 201, 1936 (food plants of larvae in Hawaii).
- Araecerus fasciculatus*, *A. vieillardii*, and *A. constans*, Zimmerman 10: 152, 1938 (the genus represented in Hawaii by three described species and some new species).
- Araecerus fasciculatus* and *A. vieillardii*, Marlowe, *ibid.* : 359 (Waimea, larvae in green and in ripe fruit of *Passiflora laurifolia*).
- Araecerus fasciculatus* and *A. vieillardii*, Swezey, *ibid.* : 362, 1940 (Oahu, from bunch of bananas in his garden).
- Araecerus vieillardii*, Swezey *ibid.* : 366, 1940 (reared from banana bunch, Manoa Valley, Oahu).
- Araecerus fasciculatus*, Sakimura and Linford, *ibid.* : 452, 1940 (Lanai, ripe pineapple fruit and old fruits of *Melia azedarach*).
- Areocerus* sp., Holdaway and Nishida, 11: 167, 1942 (Oahu, Ewa Plantation, September, in freshly threshed dry beans).
- Araecerus fasciculatus* and *A. vieillardii*, Holdaway and Look, *ibid.* : 257, 1942 (Hawaii Agric. Exper. Station, dry garden beans).
- Araecerus fasciculatus* and *A. vieillardii*, Krauss, 12: 88, 1944 (Maui; Molokai).
- Araecerus fasciculatus*, Swezey, 12: 358, 1945 (intercepted in California on *Dendrobium macrophyllum* from Borneo).

## The Identity and Host Plants of Blossom Midge in Hawaii<sup>1</sup> (Diptera: Cecidomyiidae: Contarinia)

By D. D. JENSEN

University of Hawaii Agricultural Experiment Station

(Presented at the meeting of November 12, 1945)

### INTRODUCTION

A small cecidomyiid midge which frequently infests the flower buds of tomato has been known to exist in Hawaii since 1906 when Dr. O. H. Swezey (13)<sup>2</sup> of the Hawaiian Sugar Planters' Association Experiment Station reared adults from larvae infesting tomato buds. Until the present report, published literature, summarized below, listed at least four species of *Contarinia* as occurring in Hawaii. These were:

- (1) *Contarinia sorghicola* (Coq.), the sorghum midge.
- (2) *C. solani* (Rübs.), on tomato.
- (3) *C. maculipennis* Felt, on hibiscus and pikake (*Jasminum sambac*).
- (4) *C. lycopersici* Felt, on tomato, eggplant and pepper.

The distinctive sorghum midge is well known and has not been confused with other species in Hawaii. However, knowledge of the biological and taxonomic relationships of the flower-infesting *Contarinia* in Hawaii has been confused in the past. The purpose of this paper is to present evidence indicating that the tomato-infesting midge, which was referred to in the literature as *Contarinia solani* (Rübsaamen) in earlier years and as *C. lycopersici* Felt during recent years, is the same species found infesting hibiscus (and several other plants discussed later). The bud midge from hibiscus was described by Felt as *C. maculipennis*. Host and breeding records, which demonstrate that the blossom midge in Hawaii breeds in a singularly wide range of hosts, are summarized. These include more plant families than have been known for any other species of gall midge thus far reported.

### LITERATURE

In the first record of blossom midge from Hawaii, Swezey (13) listed the species under the name *Contarinia solani* (Rübsaamen). This name correctly applies to a species which had been reared

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<sup>2</sup> Figures in parentheses refer to literature cited at the end of the article.

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from the blossoms of *Solanum dulcamara* in Germany and was described by Rübsaamen (12) in 1891. Swezey's original note follows: "*Contarinia solani* was bred from tomato buds where the larvae fed upon the young ovary of the blossom causing the buds and blossoms to blight and eventually fall off. The larvae of this species also pupate in the ground."

In 1911 Felt (5) described as *C. lycopersici* a species which had been reared from tomato flowers at St. Vincent, West Indies. Felt stated that *lycopersici* is related to *solani* but is a distinct species.

Barnes (1) in 1932 recorded the presence of *C. lycopersici* in Trinidad, West Indies where it was found infesting the flowers of tomato.

Tucker (14) in 1935 reported that several tomato fields in Barbados, West Indies had been infested with a blossom midge which did considerable damage to the flowers. The species had not been identified, but Tucker suggested it was *C. lycopersici*. In 1937 Barnes (2) confirmed the presence of *lycopersici* in Barbados.

Barnes (2), who had not had the opportunity of examining the blossom midge of Hawaii, but had studied specimens of *lycopersici* from the West Indies, commented in 1937 on the reported occurrence of *C. solani* in Hawaii as follows: "I believe that this is an erroneous identification and that the midge in question must be *C. lycopersici* Felt which is closely allied to *C. solani* but is distinct. *C. lycopersici* was described from larvae doing exactly the same type of damage to tomato buds in St. Vincent, West Indies, as O. H. Swezey described was taking place on Oahu."

In 1938 Illingworth (11) called attention again to blossom drop of tomato in Hawaii due to infestations of blossom midge.

In 1941 Callan (4) summarized the known distribution of *C. lycopersici*. He listed Trinidad, St. Vincent, Barbados, Grenada, St. Lucia and Dominica in the West Indies, British Honduras in Central America, British Guiana in South America, and Hawaii. Callan's record for Hawaii was based upon the conclusion of Barnes, cited above, regarding the identity of the species in Hawaii. All collections reported by Callan and earlier writers were made from tomato blossoms.

On the basis of observations and collections by members of the University of Hawaii Agricultural Experiment Station, Holdaway (8) in 1944 listed blossom midge, under the name *C. lycopersici*, as a submajor pest of eggplant and pepper as well as of tomato in Hawaii. In 1945 blossom midge was again listed by Holdaway *et al* (9) as a potentially serious pest of tomato, eggplant and pepper in Hawaii.

In 1933 Felt (6) described, as *Contarinia maculipennis*, a midge which O. H. Swezey had reared from the buds of hibiscus in Hawaii.

Illingworth (10) in 1934 stated that he had received hibiscus buds infested with midge larvae from the island of Hawaii about 1928.

Fullaway (7) in 1934 reported breeding the "hibiscus bud midge" from buds of *Jasminum sambac* (pikake).

#### EVIDENCE OF THE COIDENTITY OF MIDGES INFESTING DIFFERENT HOST PLANTS IN HAWAII

In April 1944 the writer began an investigation of the ecology and life history of blossom midge in Hawaii. Among the first objectives of this study was the determination of the identity and host range of the midge occurring on tomato. This species was believed by Holdaway *et al* (8, 9) to be the same as that infesting pepper and eggplant. Examination of material in the collection of the University of Hawaii Agricultural Experiment Station revealed specimens reared from *Momordica charantia* (bitter melon) and from *Brassica chinensis* (white mustard) which appeared to be identical with those reared from tomato, eggplant and pepper. During the course of the investigation, similar midges were reared from *Solanum rantonnetii* Carr. (Paraguay nightshade) and *Solanum tuberosum* L. (potato) as well as from several species of *Lycopersicon*. These and other records are summarized later in this paper.

Until January 1945 bud midge from hibiscus and *Jasminum sambac* had not been seen by the writer. It had been assumed that this midge, described as *C. maculipennis* Felt, was distinct from the species infesting crop plants. A field observation provided the first hint of their coidentity.

On January 3, 1945 the writer encountered a blossom midge infestation in a field of tomatoes in the upper Kipapa region near Wahiawa, Oahu. The number of tomato plants and blossoms found infested with midge larvae diminished with increased distance from one corner of the field. At the edge of the field in this corner occurred a hibiscus bush 80 per cent of the buds of which were infested with midge larvae. The close proximity of the infested hibiscus to the portion of the tomato field in which the highest incidence of midge infestation occurred suggested that hibiscus had served as the source of infestation for tomato. Moreover, this circumstance also suggested that the midge described from hibiscus as *C. maculipennis* Felt was not a distinct species from the one commonly infesting tomatoes in Hawaii and provisionally called *lycopersici*.

Midge adults reared from tomato and hibiscus appeared identical to the writer. However, in order to obtain more conclusive evidence that only a single species was involved in the infestations found on plants of different families, the experiments described below were conducted and specimens from the various hosts were submitted to



Dr. H. F. Barnes<sup>3</sup> of the Rothamsted Experimental Station, England, for examination.

Midge adults that were reared from larvae infesting hibiscus in the field were caged January 18, 1945 on Bounty tomato plants growing in clay pots in the University of Hawaii greenhouse at Honolulu. Five days later, mature tomato flowers and unopened buds in varying stages of development were examined for the presence of midge larvae. Several buds and a few open blossoms were found to be infested. In addition, a few buds carried midge eggs alone or eggs and a few first instar larvae on the inner walls of the syngenesious androecium. Most of the infested buds were approaching maturity but had not yet opened. The larvae were transferred from the tomato buds to glass vials containing moist soil. They immediately entered the soil where they subsequently pupated. The first adults emerged 14 days after the larvae had entered the soil.

As a parallel experiment, midge adults reared from larvae infesting tomato buds and blossoms in the field were also caged on tomato plants in the greenhouse. They oviposited in the tomato buds and the duration of the life cycle coincided with that of the midges originally reared from hibiscus and later bred on tomato under cage conditions.

Uncaged tomato plants of the same size and variety as those used in the above experiments were maintained as controls. They were kept on the same bench with the test plants and remained free from infestation during the experiments.

On March 17, 1945 midge adults reared from larvae naturally infesting *Jasminum sambac* (pikake) were caged on two Bounty tomato plants,<sup>4</sup> to determine if they would breed on tomato. Seven days later 15 infested buds were removed from the caged test plants. A few buds carried eggs and very small larvae, but the majority of buds contained larvae which were mature or approaching maturity. These were transferred to pupation vials containing moist soil. The first adults emerged on the 13th day after the larvae had been transferred to the pupation vials.

The midges reared on tomato, as progeny of parents reared from hibiscus and pikake, appeared to the writer to be indistinguishable from specimens reared from naturally infested tomatoes. Their coidentity was confirmed by Dr. Barnes as discussed later in the paper.

After determining that midges reared from field infestations of hibiscus and *Jasminum sambac* would breed on tomato, the specimens involved in these experiments as well as material reared from

<sup>3</sup> Dr. Barnes is an eminent authority on the taxonomy of this difficult family and his interest in the problem is greatly appreciated.

<sup>4</sup> Pupation jars containing emerging adults and also larvae and pupae in various stages of maturity were placed inside the experimental cages. Therefore, adults emerged daily for several days after the initial introduction on March 17.

the following hosts were sent to Dr. Barnes for identification: tomato (*Lycopersicon esculentum*), eggplant (*Solanum melongena*), Paraguay nightshade (*Solanum rantonnetii*), garden pepper (*Capsicum frutescens*), white mustard (*Brassica chinensis*), bitter melon (*Momordica charantia*), hibiscus, and pikake (*Jasminum sambac*). Since sending these specimens to Dr. Barnes, blossom midge has also been reared from Irish potato (*Solanum tuberosum*).

Dr. Barnes compared the specimens from Hawaii with *C. lycopersici* bred from tomato in Trinidad and Barbados, West Indies, and also with *C. solani* reared in England. His analysis of the problem is summarized below. Quotations are from Dr. Barnes' letter to the writer dated October 1, 1945.

1. There is probably one species of *Contarinia* in Hawaii which will live on the host plants cited above.

2. Most of the specimens from the West Indies "agree better with Felt's original description of *lycopersici* than with his description of *maculipennis*." However, certain individuals from Trinidad resemble very closely the specimens from Hawaii.

3. All of the specimens from Hawaii, with the exception of those from white mustard which were too broken to permit satisfactory examination, agree more closely with Felt's *maculipennis* description than with his description of *lycopersici*. However, Dr. Barnes writes, "There is considerable variation in the accepted specific characters and a special study is needed of individuals reared under different conditions and on different plants."

4. There is considerable evidence suggesting that the midge in Hawaii is the same species as *C. lycopersici* which occurs on tomato in the British West Indies. "The weight of biological evidence would justify your sinking *maculipennis* as a synonym of *lycopersici*." Nevertheless, Barnes would prefer postponement of such action until experiments can be conducted in the British West Indies to determine if *lycopersici* in that region is also capable of breeding on the different plant hosts reported from Hawaii.

#### HOST AND COLLECTION RECORDS OF BLOSSOM MIDGE IN HAWAII

The host range of this midge (probably *C. lycopersici*) is of unusual significance because it includes species in five different plant families. Gall midges in general have a very narrow host range. Barnes (3) in 1939 reported, "The only recorded instance of a gall midge living on plants belonging to two families is that of *Macrolabis corrugans* F. Lw. which is reported to live on certain Umbelliferous and Labiate species."

Blossom midge adults have been reared from larvae found infesting the flower buds of all the plants listed in table 1. In addition, with but a few exceptions, midges were reared to the adult stage to provide the records which are listed under each host.

Table 1. Host and Collection Records of Blossom Midge in Hawaii

HOST PLANT	DATE	LOCALITY*	COLLECTOR
SOLANACEAE			
<i>Lycopersicon esculentum</i> Mill. (tomato)	6-3-42	U. H., Manoa	F. G. Holdaway & T. Nishida
	6-24-42	U. H., Manoa	T. Nishida
	4-29-44	U. H., Manoa	D. D. Jensen
	5-3-44	U. H., Manoa	D. D. Jensen
	5-16-44	U. H., Manoa	D. D. Jensen
	6-20-44	Waialua	D. D. Jensen & T. Nishida
	12-4-44	Kipapa Airfield	D. D. Jensen
	1-3-45	Upper Kipapa	D. D. Jensen
	1-11-45	Koko Head	D. D. Jensen
	2-13-45	Poamoho	D. D. Jensen
	7-25-45	Poamoho	Reported by W. A. Frazier
<i>L. peruvianum</i> var. <i>dentatum</i> Dun.	5-1-44	U. H., Manoa	D. D. Jensen
<i>L. peruvianum</i> var. <i>humifusum</i> Mull.	5-1, 3-44	U. H., Manoa	D. D. Jensen
<i>L. pimpinellifolium</i> (Jusl.) Mill.	5-4, 6, 9-44	U. H., Manoa	D. D. Jensen
<i>L. esculentum</i> x <i>L. pimpinellifolium</i> (Jusl.) Mill.	5-1-44	U. H., Manoa	D. D. Jensen
<i>L. esculentum</i> x <i>L. hirsutum</i> Humb. & Bonpl.	5-3-44	U. H., Manoa	D. D. Jensen
<i>L. (hirsutum</i> x <i>esculentum</i> ) x <i>peruvianum</i> (L.) Mill.	8-3-45	Poamoho	D. D. Jensen
<i>Capsicum frutescens</i> L. (pepper)	5-10-43	Kaimuki	E. Akamine
	6-4-43		
	7-23-43	Kaimuki	T. Nishida
	6-20-44	Waialua	D. D. Jensen & T. Nishida
	3-21-45	U. H., Manoa	D. D. Jensen
	4-17-45	U. H., Manoa	D. D. Jensen
	5-22-45	U. H., Manoa	D. D. Jensen
<i>Solanum melongena</i> L. (eggplant)	5-10-42	Kaimuki	E. Akamine
	6-7-42	Pauoa Valley	T. Nishida
	2-16-43	Haiku, Maui	J. Shigeta
	4-28-43	Manoa	T. Nishida
	8-15-42	U. H., Manoa	T. Nishida
	6-4-43	Kaimuki	E. Akamine
<i>Solanum rantonnetti</i> Carr. (Paraguay nightshade)	7-11, 26-44	Honolulu	T. Nishida
<i>Solanum tuberosum</i> L. (potato)	5-25-32	Waianae	O. H. Swezey
	5-15-45	Waipahu	D. D. Jensen

\* All collections listed were made on Oahu unless otherwise indicated.

Table 1.—Continued

HOST PLANT	DATE	LOCALITY*	COLLECTOR
<b>CUCURBITACEAE</b>			
<i>Momordica charantia</i> L. (bitter melon)	2-16-43	Haiku, Maui	J. Shigeta
	3-2-45	Haiku, Maui	D. D. Jensen
	5-15-45	Waipahu	D. D. Jensen
<b>MALVACEAE</b>			
<i>Hibiscus</i> sp.	1-3-45	Upper Kipapa	D. D. Jensen
	1-26-45	Manoa	D. D. Jensen
	2-7, 16-45	Manoa	D. D. Jensen
<b>OLEACEAE</b>			
<i>Jasminum sambac</i> Soland. (pikake)	1-11-45	Kaimuki	D. D. Jensen
	3-2-45	Waihee, Maui	D. D. Jensen
	3-19-45	Waiau	D. D. Jensen
<b>CRUCIFERAE</b>			
<i>Brassica chinensis</i> L. (white mustard cabbage)	1-2-43	U. H., Manoa (greenhouse)	T. Nishida

\* All collections listed were made on Oahu unless otherwise indicated.

*Lycopersicon esculentum* Mill. (tomato). Blossom midge infestations in common tomato have varied in severity in Hawaii from a fraction of 1 per cent to over 80 per cent of the mature buds sampled. These observations agree with those reported by Callan (4) from Trinidad where *Contarinia lycopersici* was found infesting from 1.1 per cent to 83 per cent of the tomato flowers examined.

*Capsicum frutescens* L. (garden pepper). In several instances practically 100 per cent of the flowers of peppers in small private garden plantings have been found infested with midge larvae.

*Solanum melongena* L. (eggplant). Eggplant may at times be subject to heavy infestation by blossom midge. However, tomato and pepper may be preferred hosts because, on several occasions, midge larvae have been found infesting these plants growing in close proximity to non-infested eggplants.

*Solanum tuberosum* L. (potato). Blossom midge has been reared from Irish potato blossoms on only two occasions. However, this paucity of records from potato may be due to factors other than host preference. Since an infestation in potato blossoms does not result in economic loss, as is the case with infestations of tomato, pepper and eggplant flowers, the presence of midge larvae in potato blossoms ordinarily would go unnoticed. Moreover, potatoes do not blossom profusely in Hawaii. Furthermore, much of the potato acreage in the Territory is not grown in close proximity to perennial hosts of midge which might serve as ready sources of infestation.

The specimens reared from potato have not yet been submitted to Dr. Barnes for determination. However, there is little doubt that they will prove to be the same species that breeds on the other host plants listed.

*Solanum rantonnetii* Carr. (Paraguay nightshade). This plant is very rare in Hawaii. It was not known to exist here until July 1944 when Mr. T. Nishida of the University of Hawaii Agricultural Experiment Station submitted a specimen to Miss Marie Neal of the Bishop Museum for identification. He found most of the blossoms heavily infested with pepper weevil larvae. A few buds were found to harbor small dipterous larvae which were called to the attention of the writer. They were reared to the adult stage and proved to be blossom midge.

*Momordica charantia* L. (bitter melon). Mr. Shigeta reported severe damage by midge larvae to bitter melon flowers. Infested blossoms failed to open and hence did not become pollinated. Although the writer found infested blossoms at Haiku, Maui and at Waipahu, Oahu the percentage infestation was extremely low.

*Hibiscus* sp. Although only a few infestations of midge on hibiscus have been recorded, it is apparent that at times most of the blossoms on a bush may be infested. Over 80 per cent of the buds on a single plant in the upper Kipapa district were found infested on January 3, 1945.

*Jasminum sambac* Soland. (pikake). Pikake, which produces a profusion of blossoms, is apparently an important host of the midge. Since it is a perennial plant, grown in commercial stands to produce flowers for the lei industry, it may prove to be one of the key host plants in maintaining a midge population throughout the year. Over 75 per cent of the living buds sampled were found infested in the January 11, 1945 collection reported above.

*Brassica chinensis* L. (white mustard cabbage). This plant has not yet been found infested in the field. The single record to date is based on an infestation which developed on plants grown in the greenhouse. A note accompanying the collection data stated that the midge larvae were "fairly abundant" and that they occurred also on tomato flowers.

#### SEASONAL OCCURRENCE AND ABUNDANCE OF BLOSSOM MIDGE IN HAWAII

It has not yet been possible to make a consistent and detailed investigation of the abundance and distribution of blossom midge during each month of the year. However, the collection records summarized above reveal that this species apparently breeds in some of the solanaceous crop plants throughout the year. Collec-

tions have been made from either tomato, pepper or eggplant during every month of the year except September, October and November. It is probable that a careful search will reveal infestation during these months as well.

Most of the infestations which have been reported as a result of midge damage have occurred during the spring and early summer months, particularly May and June. However, during a search for the midge at other seasons, extremely heavy infestations were found on hibiscus and *Jasminum sambac* in January.

### SUMMARY

1. Experiments are reported which demonstrate that the gall midge, *Contarinia maculipennis* Felt, which infests hibiscus in Hawaii, is the same species which breeds in tomato blossoms and was known in Hawaii under the names *Contarinia solani* (Rübsaamen) and *C. lycopersici* Felt. Midge adults reared from hibiscus and *Jasminum sambac* have been shown to breed on tomato where they complete a life cycle indistinguishable from that of specimens originating on tomato.

2. The biological evidence reported and a comparison of specimens from Hawaii with *lycopersici* from the British West Indies indicate the probability that the species occurring in Hawaii is also *lycopersici*. If such is the case, the name *maculipennis* is a synonym of *lycopersici*. However, in the West Indies *lycopersici* has been recorded only from tomato while the species in Hawaii is now known to breed in several unrelated plants. This fact makes it inadvisable at present to relegate the name *maculipennis* to synonymy, since the possibility exists that the midge in the West Indies is biologically distinct from the midge in Hawaii despite the apparent absence of consistent morphological differences.

3. In Hawaii blossom midge has been reared from the following host plants: SOLANACEAE: *Lycopersicon esculentum* (tomato), *L. pimpinellifolium*, *L. peruvianum*, *Capsicum frutescens* (garden pepper), *Solanum melongena* (eggplant), *Solanum tuberosum* (Irish potato), *Solanum rantonnetii* (Paraguay nightshade); CRUCIFERAE: *Brassica chinensis* (white mustard or pak choy); CUCURBITACEAE: *Momordica charantia* (bitter melon); MALVACEAE: Hibiscus; OLEACEAE: *Jasminum sambac* (pikake).

The wide host range of blossom midge in Hawaii, involving five different plant families, is unique among gall midges of the family Cecidomyiidae. Only one other species has been recorded from plants belonging to more than one family, and in this instance only two plant families are involved.

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## Virus Diseases of Plants and Their Insect Vectors with Special Reference to Hawaii

By D. D. JENSEN

University of Hawaii Agricultural Experiment Station

*(Presidential address, delivered December 10, 1945)<sup>1</sup>*

This subject will be divided into the following three general parts:

Part I. Principles of insect transmission of plant viruses.

Part II. Insect species occurring in Hawaii known to transmit plant viruses, with a list of viruses transmitted by each.

Part III. Plant virus diseases known or reported to occur in Hawaii with special reference to their transmission by insects.

### Introduction

The entomological and pathological implications of the war are far-reaching and it will probably be several years before their full significance for Hawaii can be evaluated. However, the handwriting is already on the wall. Despite the vigilance of our quarantine inspectors and the cooperation of the Army and Navy it is already apparent that undesirable insect species which were previously absent from Hawaii are being introduced. The exact manner in which recent insect arrivals reached the Territory has not been determined. Until recent years most of them were brought by boat. However, the heavy plane traffic through Hawaii during and since the war provides a means of insect entry which is a more serious hazard than that attending the slower water craft.

Several immigrant species have been discovered in Hawaii during the past two years. Because of their conspicuousness and the rapidity with which they have become abundant, some of these can be considered very recent arrivals—possibly by plane.

Quarantine inspectors in Hawaii have intercepted a number of living insects in planes which arrived from the mainland or from other Pacific areas. Due to the short period of time required by modern planes to travel thousands of miles, even delicate forms, such as aphids and leafhoppers, which cannot survive many hours away from suitable hosts, may reach Hawaii alive. Most of these insects are killed by spraying before they can escape from the planes. It is probable, however, that during the early part of the war before treatment of military planes had become a well established practice, or as a result of crash landings or other emergencies,

<sup>1</sup> Because of the length of the paper, the actual address as delivered was confined to Part I and representative portions of Parts II and III.



insects reached Hawaii by planes from which they escaped alive. Furthermore, the most rigid quarantine system that can be put into practical service cannot hope to intercept all insects which reach Hawaii. This service is, however, successful in reducing the introductions to a fraction of what they would be if no regulations were in effect.

This problem has a direct bearing on the subject I have chosen for discussion today, because the hazard of introducing new virus diseases by means of viruliferous insects, or of introducing more efficient vectors of viruses already established, is greatly increased by aircraft, particularly under conditions imposed by war.

This discussion will be confined primarily to the entomological aspects of virus problems. Furthermore I shall not undertake a treatment of all known plant viruses or their vectors but shall deal in particular with the viruses and vectors known to occur in Hawaii. In addition, certain viruses not known to occur in Hawaii will be considered briefly because of the bearing they have on the virus problems of the Territory.

A review of the literature on virus diseases and virus research in Hawaii reveals that although a considerable number of viruses occur here, most of them have received only passing notice. Those which have been investigated most extensively are: yellow spot of pineapple (spotted wilt of tomatoes), sugar cane mosaic, chlorotic streak of sugar cane, corn mosaic, and to a lesser extent papaya mosaic and *Commelina* mosaic. Other viruses occur on truck crops, banana, ornamental flowers and weed hosts. These received little attention in earlier years because the plants on which they occurred played a very minor role in the agricultural economy of the Territory, or the viruses were not known to cause serious damage to their host plants.

The increasing importance assumed by diversified crops in Hawaii has resulted in a greater awareness on the part of entomologists and pathologists of the importance of virus diseases on the respective crops. Furthermore, the number and importance of these problems are usually found to increase as the acreage which is devoted to the crops in question increases.

## PART I. PRINCIPLES OF PLANT VIRUS TRANSMISSION BY INSECTS

Before discussing particular diseases and insect vectors which occur in Hawaii, the nature of viruses and some of the pertinent general principles and problems associated with the transmission of viruses by insects will be considered briefly.

I—*Nature of viruses.* The ultimate nature of viruses has been the subject of speculation for many years. Because they are known to multiply only in living cells, and because they exhibit other properties which are usually considered characteristic of living organ-

isms, the opinion was prevalent until recent years that viruses were living entities. The announcement by Stanley (218, 219)† in 1935 and 1936 that he had isolated what appeared to be pure tobacco mosaic virus, and that it was composed of a crystalline protein of high molecular weight, was therefore an important milestone in virus research. Stanley also demonstrated (220) that by chemical treatment, the structure of this protein, which was shown by Bawden and Pirie (10, 11) to be a nucleoprotein, could be altered with resultant loss of virus activity. Reversal of this process restored the original structure of the protein and virus activity was thereby regained. Other workers have confirmed Stanley's results and several other viruses have since been demonstrated to be nucleoproteins of chemical structure similar to but distinct from that of tobacco mosaic.

II—*Transmission of plant viruses.* All plant viruses can probably be transmitted to susceptible hosts by grafting, providing grafts can be established. A few are transmitted through the seed and many can be transmitted by mechanical inoculation. However, the most important manner in which viruses spread from plant to plant in nature is by means of their insect vectors. Although the majority of insect species which transmit plant viruses occur among the aphids and leafhoppers, several species in other groups have also been incriminated as vectors. Below is given a list of the arthropod groups which have been reported as containing vectors of plant viruses. The species names are given for the vectors in all groups except the aphids and leafhoppers which comprise an extended list.

#### ARTHROPOD VECTORS OF PLANT VIRUSES

(Exclusive of the major groups of vectors, i.e., Aphididae, Cicadellidae)

*Note:* Further confirmation is needed of the transmitting ability of species whose names are preceded by an asterisk.

Species	Virus	References
ACARINA		
<i>Eriophyes ribis</i> Nalepa	Black-currant reversion disease virus	4, 96
INSECTA		
Orthoptera		
<i>Melanoplus</i> spp.	Potato spindle tuber virus	82
COLEOPTERA		
<i>Diabrotica vittata</i> Fab.	Cucumber mosaic virus	51, 52
<i>D. duodecimpunctata</i> (Fab.)	Cucumber mosaic virus	122
<i>D. soror</i> Lec.	Cucumber mosaic virus	9
<i>Leptinotarsa decimlineata</i> Say (larvae)	Potato spindle tuber virus	122
LEPIDOPTERA		
<i>Pieris rapae</i> (Linn.)	Cabbage mosaic virus	121

† Figures in parentheses refer to literature cited at the end of the article.

Species	Virus	References
<b>DIPTERA</b>		
* <i>Tipula paludosa</i> Meigen (larvae)	Potato spindle tuber virus	59
<b>THYSANOPTERA</b>		
Thripidae		
<i>Thrips tabaci</i> Lind.	Tomato spotted wilt virus	125, 187
<i>Frankliniella nigripes</i> (Girault)	Tomato spotted wilt virus in Australia	8, 201
<i>F. schultzei</i> (Trybom)	Tomato spotted wilt virus in S. Africa	148, 149
<i>F. moultoni</i> Hood	Tomato spotted wilt virus in N. America	76, 77, 78
<i>F. paucispinosa</i> Moulton	Tomato spotted wilt virus in S. America	65
<b>HEMIPTERA</b>		
Piesmidæ		
<i>Piesma quadrata</i> Fieb.	Beet leaf curl (Kräuselkrankheit) virus	96
<i>P. cinerea</i> (Say)	Beet savoy virus	96
Miridæ		
<i>Lygus pratensis</i> Linn.	Rape savoy virus	96
	Potato spindle tuber virus	82
	Potato mosaic virus	59
<b>HOMOPTERA</b>		
Coccidæ		
* <i>Pseudococcus maritimus</i> (Ehrhorn)	Bean mosaic virus	58
* <i>P. citri</i> (Risso)	Tobacco mosaic virus	164
* <i>Lecanium corni</i> Bouché	Vine mosaic virus	214
Aleyrodidæ		
<i>Bemisia gossypiperda</i> Misra and Lamba	Cotton leaf curl virus	80
<i>B. nigriensis</i> Corb.	Cassava mosaic virus	81
Psyllidæ		
* <i>Mesohomotoma tessmani</i> (Aulm.)	Cacao swollen shoot disease virus	189
Cercopidæ		
<i>Philacnus leucophthalmus</i> (Linn.)	Peach yellows virus	130
Delphacidæ		
<i>Peregrinus maidis</i> (Ashm.)	Corn mosaic virus	115
<i>Perkinsiella saccharicida</i> Kirk.	Sugar cane Fiji disease virus	150
<i>P. vastatrix</i> Breddin	Sugar cane Fiji disease virus	159

### INSECT TRANSMISSION OF VIRUSES

Virus diseases fall into two general groups on the basis of the insect vector relationships involved. The factors which determine these various vector-virus relationships are of fundamental importance from the standpoint of the biological phenomena involved as well as because of their economic importance in the dissemination of virus diseases.

One type of transmission is that in which the vector is able to transmit the virus immediately or within a very short time after it first feeds on a diseased plant. Such viruses are usually not retained

by their vectors for more than a short time after the vectors feed on healthy or immune plants. Watson and Roberts (237) have called this the "non-persistent" type of virus.

The other general type, designated as "persistent" viruses, includes those which must undergo a latent or incubation period in their insect vectors before the latter are capable of infecting healthy plants. This period varies from less than an hour up to several weeks depending upon the vector and virus involved. Furthermore, the vectors of persistent viruses retain the ability to infect healthy plants during much or all of their subsequent life without the need of feeding again on a virus source.

*Non-persistent viruses.* Viruses of the non-persistent type have the following general characteristics:

1. They usually require no incubation period in the vector.
2. They are not long retained by the vectors after the latter leave a diseased plant.
3. They are usually transmissible by mechanical means.
4. There is usually a relatively low degree of specificity between the virus and its vectors, particularly with reference to the aphids. Most of these viruses can be transmitted by several species. There are no well authenticated cases of leafhoppers transmitting non-persistent viruses.

Most of the virus diseases known in Hawaii are of the non-persistent type. A few of this type are transmitted mechanically with such ease that much of the spread in the field may be traceable to contaminated tools, clothing or hands. Two of our most common virus diseases—tobacco or tomato mosaic and cucumber mosaic—are among those which can easily be transmitted mechanically. The former, however, is paradoxical in that it is very difficult to transmit by means of insects.

Because of this ease of transmission by mechanical means, the idea has become accepted by many people that insect transmission of non-persistent viruses is also a purely mechanical process resulting from contamination of the vector's mouthparts. Yellow dwarf of onions, which has been transmitted by more than 50 species of aphids, is usually cited as an example of mechanical transmission by sucking insects. Other viruses which have been placed in this group are those causing potato spindle tuber and common cucumber mosaic. These are included in this group because they are easily transmissible by juice inoculation and also because several chewing insects, in addition to a number of sucking species, have been listed as vectors. Mechanical transmission of viruses by insects probably occurs in some cases, but recent work indicates that transmission by most sucking insects may involve biological as well as mechanical factors. Cucumber mosaic is a case in point.

Studies by Watson and Roberts (237) in 1939 on transmission of cucumber mosaic, Hyoscyamus virus 3 and potato virus Y by means of aphids, produced some unusually noteworthy results on this subject. They tested the transmitting efficiency of *Myzus persicae* (Sulz.), *M. circumflexus* (Buck.) and *Macrosiphum solanifolii* (Ashm.) under various conditions. It was found that the efficiency of the vectors was greatly increased if they were prevented from feeding for a time just prior to being placed on the disease inoculum. The transmitting efficiency increased with increased fasting time up to 1 hour. This unusual effect was obtained, however, only if the time the aphids fed on the source of the virus was reduced to a short period immediately preceding transfer to the healthy test plants. A 2-minute feeding period on inoculum was found to be most satisfactory. The efficiency of previously starved aphids decreased as the time of feeding on the infected plants increased. If this time was extended to an hour there was no increase in efficiency over unstarved aphids. The explanation suggested by the authors for the results reported was that the viruses are inactivated by some substance, such as an enzyme, produced by the aphids during feeding. This substance, according to their hypothesis, is not produced, or at least not in effective quantities, while the aphids are fasting. Furthermore, for several minutes after feeding is resumed, the inactivating substance may not be produced in sufficient quantity to inactivate the virus being ingested. Hence, fasting and short feeding periods result in increased efficiency of virus transmission.

Watson and Roberts also found that the species of aphids varied in their efficiency as vectors despite the fact that during the short feeding periods reported, all three species fed in the same parenchyma tissue. In view of the varying efficiency of the species, while feeding in the same tissue under the same conditions, the authors concluded that aphid transmission in these instances involves a complex vector-virus relationship and that the viruses are not transmitted mechanically. *M. solanifolii* was the least efficient of the three species under consideration. This was explained on the basis of more inactivating substance being produced by this aphid. Kasanis (110, 111) obtained similar results with the same and other species of aphids in transmitting tobacco etch viruses. In these experiments, efficiency was greatest if the aphids were starved for 4 hours and then fed for 2 minutes on inoculum before being transferred to healthy test plants.

These experiments are in contrast to differential efficiency exhibited by the same species of aphids in transmitting potato leaf roll (55) where high efficiency was correlated with phloem feeding which required longer periods of feeding time on the inoculum.

As further evidence that loss of infectivity by aphids is not due to cleansing of the mouthparts during feeding, Watson and Roberts (238) demonstrated that individuals of *Myzus persicae* may infect

a succession of healthy plants if the aphids are first subjected to a fasting period followed by a 2-minute feeding on infected plants before transfer to the healthy test plants. In contrast to these results unstarved infective aphids are usually unable to infect a second healthy plant if they are allowed to feed on the first plant for several minutes. The aphids which fed discontinuously, inserted and removed their stylets from as many as 10 different healthy plants before losing infectivity. During the same time interval, unstarved infective aphids feeding continuously on a single healthy plant lost the ability to transmit the disease. Therefore, it seems highly improbable that such viruses are only mechanically transmitted and are lost by being rubbed off during insertion and withdrawal of the insect stylets through healthy plant tissue.

On the basis of these experiments Watson and Roberts concluded that the presence of the hypothecated inactivating substance is the primary difference between the so-called non-persistent viruses and those which persist in their vectors. However, this hypothesis does not provide an explanation for the incubation period of viruses of the persistent type in their insect vectors. Retention of the persistent type virus by the vector for indefinite periods might be explained by the absence of an inactivating substance, but in such a case some other fundamental process or mechanism must be responsible for the latent period of the virus in the vector before transmission is possible. Furthermore, the factors involved in this process may be more complex than those which permit indefinite retention of the virus. However, since viruses which require an incubation period in their vectors are also always retained by the vectors for indefinite periods of time, it is probable that the factors governing the two phenomena are the same or at least are intimately associated.

*Viruses of the persistent type.* Viruses of the persistent type usually have the following characteristics:

1. A latent or incubation period in the body of the insect vector. This is the period between the acquisition of the virus by the insect and the time when the insect becomes capable of infecting healthy plants with the virus.
2. After becoming viruliferous the insect vectors usually retain the virus for an extended period of time or for life without the need of again feeding on a diseased plant.
3. The vectors are usually phloem feeders and the viruses usually produce symptoms which are associated with phloem disturbances. However, some persistent viruses occur in both phloem and parenchyma.
4. Most persistent viruses are not sap transmissible.
5. There is a greater degree of specificity between the insect vector and the virus than occurs among the non-persistent viruses.

*Incubation period in the vector.* An incubation period of the virus apparently occurs in the insect vectors of all viruses of the persistent type. In Hawaii, this has been demonstrated to occur in *Peregrinus maidis* (39) in the transmission of corn mosaic and in *Thrips tabaci* (125) during transmission of yellow spot of pineapple (spotted wilt of tomato). Presumably the incubation period shown to exist in *Myzus persicae* in transmitting potato leaf roll (215) also obtains in Hawaii, although this has not been tested experimentally.

The nature of the incubation period of the virus in the vector has been a subject of considerable discussion for a number of years but as yet no unanimity of opinion has developed on the question. The principal theories suggested to explain this latent period are: (a) that the virus must multiply itself in the body of the vector in order to develop a concentration great enough to permit emission of an infective dose by the insect; (b) that the latent period is the time required for the virus to pass through the walls of the intestine, enter the blood and make its way into the salivary glands from which it is presumably injected into the plants during feeding; (c) that it is a period during which the virus is changed in some necessary manner before the vector can transmit it.

The second theory is difficult to test because of the complications encountered in trying to detect the presence of the virus in specific tissues or fluids of the insect vector. It has been accomplished with respect to some tissues in a few insects, but not in experiments which were designed to measure the rate of virus movement through the respective tissues. As yet there has been no way discovered to obtain concrete evidence on the last theory.

The theory regarding multiplication in the insect has been reviewed by Storey (222), Leach (122) and Bawden (9). In this paper it will be discussed but briefly, and some aspects which have not been considered previously will be mentioned.

There is persuasive evidence both for and against the idea that the latent period in insects is due primarily to multiplication of the virus to an infective threshold. When sufficient facts are available they may reveal that virus multiplication occurs in some species and not in others. We can be certain that the problem is not a simple one even in the case of an individual disease and its vector. Although the incubation period of a given virus in its vector is usually constant within general limits, there may be wide differences between individuals within the same species. One of the most extreme examples is that demonstrated by Carter (39) in relation to *Peregrinus maidis* and discussed more fully later in this paper. In this species the latent period varies from 4 to 29 days. If this period is based upon multiplication of the virus, it is apparent that the physiological differences occurring among individuals or genetic

lines within a species have a direct influence on the multiplication rate.

Kunkel (119) in 1937 demonstrated that if colonies of infective leafhoppers of *Macrostelus divisus* (Uhl.) were exposed to temperatures of 31 to 32° C. for 1 day or longer, they lost the ability to transmit aster yellows virus either permanently or temporarily. A 12-day exposure to this temperature resulted in permanent inactivation of the virus in the insect. However, "colonies treated from 1 to 11 days regained ability to transmit after periods varying from a few hours up to many days. The longer the colonies were heat-treated, the longer it took them to regain ability to transmit. Colonies in which virus was undergoing natural incubation were affected to a greater degree by heat treatments than colonies that were infective at time of treatment." These results were interpreted to mean that short treatments inactivated only part of the virus and transmitting ability was regained when the virus had again increased to an infective level. The 12-day treatment was assumed to have inactivated all of the virus in the insect. The more marked effect of heat treatment on colonies in which the virus was undergoing natural incubation was construed as evidence that the quantity of virus in these insects was lower at the time of treatment than in insects already infective when treated. Kunkel showed further (120) that this leafhopper can live and reproduce normally at temperatures higher than those which inactivated the virus. This fact, together with the demonstrated ability of leafhoppers to become infective a second time by feeding on a diseased plant after all the virus had once been inactivated in them by heat treatment, are cited as adequate evidence that the loss of transmitting ability due to heat treatment resulted from an effect on the virus itself and not on the insect.

Black (17) reported experiments which were presented as additional evidence that the aster yellows virus multiplies in its vector. His technique involved transmitting the virus mechanically from insect to insect, usually at 0° C. By this method he demonstrated that juice from viruliferous insects is infectious at dilutions as high as 1:1000 in 0.85 per cent NaCl solution. Furthermore, although the minimum incubation period in mechanically inoculated insects varied from 11 to 45 days, the insects usually remained infective until they died. Black also presented evidence indicating that the virus reached its highest concentration in the insects several days before the vectors could transmit the virus to asters. Moreover, the virus concentration in some instances appeared to decrease towards the end of the incubation period. It was therefore suggested that part of the incubation period may represent a period of multiplication of the virus while the remaining portion may be the time required for the virus to move from the centers of multiplication to a site in the insect from which it may be injected into the plant.



One of the strongest arguments cited as evidence of virus multiplication in the insect vector is based on Fukushi's work with *Nephotettix apicalis*, var. *cincticeps* Uhl., the vector of rice dwarf disease. This is the only known case of a virus being transmitted through the egg of the vector to its progeny. Fukushi (72, 73, 74) in 1933, 1935 and 1939 demonstrated that congenital transmission through the egg takes place only when the female parent carries the virus. Infective progeny resulted from crosses involving viruliferous females and non-viruliferous males but not when the reciprocal crosses were made. The virus was passed from insect to insect through the egg to the 7th generation without the insects in question feeding on disease inoculum.

The justification for interpreting the various experiments reported here in the manner indicated above has been questioned by some, notably Bawden (9). The work on several other insect vectors suggests that if virus multiplication occurs, the rate must vary or else it is not fast enough to maintain the original charge of the virus. Otherwise multiplication should maintain the virus at an infective level throughout the life of the insect. This does not happen in many instances, examples of which are discussed below.

Freitag (69) showed that the ability of *Eutettix tenellus* (Baker) to transmit curly top virus diminished with increased time after completion of the incubation period. During the latter part of their lives, many leafhoppers completely lost the ability to transmit the virus or transmitted more and more infrequently. However, if such leafhoppers were permitted a second feeding on inoculum, they again became viruliferous. These results suggested that loss of infectivity had been due to exhaustion of the virus supply in the insect. This fact was confirmed for *Eutettix tenellus* by Bennett and Wallace (14), for *Cicadulina mbila* (Naudé) by Storey (222) and for *Peregrinus maidis* by Carter (39). Freitag also found that the length of the original feeding period on the virus source had an effect on the duration in the insect of infective ability. Short exposure to inoculum tended to result in a shorter infective period for the insect. A feeding period of several hours or days on inoculum usually resulted in more prolonged infectivity. However, there appeared to be a limit beyond which further inoculum feeding produced no additional effect in prolonging virus retention.

Another objection to the idea of virus multiplication in the vector is, that although the length of feeding time on the diseased plant may determine to some degree how long the virus is retained by the vector, it has little effect on the duration of the incubation period itself. This may be as long in a vector which fed for several hours or days on a diseased plant as it is for the same species when fed but a fraction of this time on inoculum. If the latent period is primarily one during which the virus must multiply to an infective

level in the insect, there should be a direct relation between the initial quantity of the virus ingested by the insect and the duration of the latent period. However, such a relationship does not exist. Even Black's experiments involving high dilutions of virus, which were considered to be evidence of multiplication in the vector, show that the incubation period in leafhoppers inoculated with the juice from viruliferous insects was as long in those inoculated with undiluted juice as it was in those inoculated with dilutions of  $10^{-1}$  and  $10^{-2}$ .

Another aspect of the problem which has not been considered is that if the incubation period of persistent viruses is due to multiplication of the virus, the minimum infective dose of such viruses must be many times that which is effective in the case of non-persistent viruses. As discussed previously, many of the latter viruses are transmitted most readily if the vector is permitted only a short feeding period of 2 minutes on the diseased plant and is then transferred immediately to the test plant. In contrast to this, even though vectors of persistent viruses are permitted to feed for several hours or days on the virus source, during which time the amount of virus ingested must be considerable, they are nevertheless incapable of infecting a healthy plant until the usual incubation period has been run.

Furthermore, the fact that infective individual vectors of persistent viruses frequently do not infect all of the plants they feed on but fluctuate irregularly in their transmitting ability, suggests that factors other than virus multiplication must also be involved.

Storey (222) cited a circumstance regarding the multiplication hypothesis which is of interest. When the virus of maize streak was introduced directly into the body of *Cicadulina mbila*, this leafhopper became infective, but within 1 to 3 weeks thereafter it again became non-viruliferous. In contrast to this, leafhoppers which were permitted to feed for only 15 seconds on a diseased plant retained the virus for 9 weeks. The reason for this is not understood, but it does show that the virus is more effective if taken in by mouth than by inoculation into the body cavity. Storey also suggested that entry by the intestinal route may be a necessary condition of multiplication if such multiplication occurs.

#### *Relation of Persistent Viruses to the Plant*

Bennett (12) has pointed out that several viruses of the type referred to here as persistent, are rather closely restricted to the phloem. However, others, such as maize streak and spotted wilt occur in both phloem and parenchyma. Most persistent viruses have also been found to be transmitted by insects which ordinarily feed in the phloem. Dykstra and Whitaker (55) correlated transmitting efficiency in aphid vectors with the tissues in which they fed. Those feeding habitually in the phloem were found to be efficient vectors of potato leaf roll.

Studies by Fife and Framptom (66) revealed the manner in which one insect, *Eutettix tenellus*, is guided to the phloem in which it must feed in order to acquire or transmit the virus of sugar beet curly top. The saliva of the leafhopper was found to be alkaline in reaction. The reaction of the parenchyma tissue of the sugar beet leaf petiole is acid, but there is a pH gradient toward the alkaline side as the phloem is approached. This gradient increases sharply in the cells of the bundle sheath and in the adjacent parenchyma cells. It reaches its highest point in the phloem where the pH is approximately the same as that of the leafhopper's saliva. It was inferred, therefore, that the acid reaction of the outer parenchyma is distasteful to the leafhopper and that the latter is guided to the alkaline phloem by the pH gradient described. This idea was supported by the feeding response of the leafhoppers on plants treated with a high concentration of carbon dioxide. This treatment upset the pH gradient in the petiole of the sugar beet with the result that the phloem was temporarily made more acid than some of the parenchyma. When *Eutettix* fed on plants of this type they reached the phloem in only 12 per cent of the trials, whereas in normal plants 56 per cent of the feeding trials terminated in the phloem.

The feeding habits of the sugar cane leafhopper, *Perkinsiella saccharicida*, and its role in transmitting Fiji disease of sugar cane present an unusual situation which is not yet fully understood. North and Barber (158) in 1935 reported that the nymphs of this insect usually feed in the phloem whereas the adults appear to be indifferent to the vascular bundles and feed in the mesophyll. Nymphs can easily be shown to acquire the virus but apparently adults do not. It is possible that the difference in feeding habits is responsible for the inability of the adults to obtain the virus. However, if this is true it will be a case in which the virus can be acquired by the vector only from the phloem but can be introduced into a healthy plant through the mesophyll as well as the phloem. This must follow because adult leafhoppers can transmit the virus provided they acquired it during their nymphal stage.

The fact that viruses of the persistent type are usually, but not always, restricted to the phloem or occur in the phloem in the greatest concentration, provides an explanation why such viruses are seldom found to be sap-transmissible. The insect vectors are equipped to introduce the virus into the phloem cells without causing the death of these or of the surrounding cells. However, the relatively crude methods of mechanically inoculating viruses which have been developed thus far make it exceedingly difficult to reach the phloem cells without causing severe disruption of the tissues penetrated. As a result, the virus fails to establish itself except in rare instances.

It is of interest in this connection that Storey (222) and Black (17) have been able to inoculate successfully the viruses of maize streak and aster yellows into their respective insect vectors by mechanical means, but that the same viruses cannot be transmitted from plant to plant mechanically. In the case of maize streak, the virus can be transferred mechanically to the vector from infective plant juice and also from the body juice and freshly expelled feces of viruliferous leafhoppers (222).

*Some factors affecting virus transmission by insects.*

One of the most intriguing problems relating to virus transmission by insects, concerns the factors which determine which insect species may serve as vectors and under what particular conditions. The problem is a complex one involving the relationships of the insect to both the virus and the plant and also the relationships of the virus to the plant. A few of the possible factors will be considered briefly.

1. Non-vector species of insects may be able to acquire a virus and retain it for extended periods of time but lack the ability to infect healthy plants. Bennett and Wallace (14) demonstrated the presence of curly top virus in non-vector species of aphids, leafhoppers, thrips and mites. When transferred to healthy plants the virus was retained by *Myzus persicae* for 14 days and by *Aceratagallia californica* (Bak.) for 21 days, yet they were unable to effect transmission. The authors concluded: "Since the virus retained its activity for several days in the bodies of the two species of insects named above and since both fed in the phloem, their inability to cause infection was not due to lack of active virus or to the tissue on which they fed, but evidently resulted from the presence of an effective barrier to virus passage in some part of the insect."

Such a barrier has been demonstrated by Storey (222) to occur in a genetic strain of *Cicadulina mbila*, the vector of maize streak virus. By selective breeding, Storey was able to produce a pure stock of leafhoppers all of the members of which could transmit the virus. Within the same species he bred another pure stock in which none of the insects could normally serve as vectors. The first stock was called the "active" race and the second the "inactive" race. When these pure races were crossed it was found that "activity" was dominant and was transmitted as a simple Mendelian character. The most significant contribution which emerged from this work was the knowledge that the barrier to activity in this species occurred in the intestinal wall of the leafhopper. Inactive individuals could be made active vectors if, after they had fed on a diseased plant, the stomach wall of the insects was punctured with a fine needle to permit some of the infective plant juice to enter the blood

in the body cavity. The same result could be obtained by injecting infective plant juice or extracts from infective insects directly into the body cavity of inactive individuals.

2. Insects may be capable of acquiring the virus during only one of the life stages. This is true of thrips and apparently is also true of *Perkinsiella saccharicida* in transmitting spotted wilt and Fiji diseases respectively. In both instances the virus apparently must be acquired before the adult stage is reached. However, infective nymphs develop into adults capable of transmitting the virus. The reason for this is not understood. It is possible that a change takes place in the permeability of the intestinal wall which prevents passage of the virus in adults. This possibility might be tested by applying the same technique Storey (222) used in making vectors of "inactive" *Cicadulina mbila*. In the case of the sugar cane leafhopper the reason may also be found in the different feeding habits of the nymphs and adults as discussed earlier.

3. The insect vector may be able to acquire the virus from one host plant but not from a related species which also carries the virus. This has been demonstrated to be the case in aphid transmission of tobacco mosaic virus from tomato but not from tobacco. The same species of aphids may however transmit other viruses to and from tobacco. Black (16) and others have proved that the juices of several insect vectors inhibit the infectivity of tobacco mosaic and several other viruses. As yet, however, it has not been demonstrated that failure of insects to transmit viruses is due to virus inactivation by the living insects, although the work of Watson and Roberts discussed earlier is very suggestive in this regard.

4. Another question which bears on the role of insects in transmitting virus diseases pertains to the manner in which an infective quantity of virus is introduced into the plant. It is common knowledge that many viruses can be transmitted at will by the use of a large number of vectors whereas tests involving individual insects often result in no transmission or in but a small percentage of positive cases.

Carsner and Lackey (33) and Severin (204) have advocated the "mass action" hypothesis. According to this idea, the increased percentage of transmission provided by groups of insects over individuals is partially due to the combined effect of several small, sub-infective doses of virus, any one of which alone would not have been sufficient to cause the disease. In contrast to this idea, Storey (222) and others hold that "a group will succeed if at least one of its members would have succeeded alone; if none would have succeeded alone, then the group will not succeed."

The same viruses and vectors were not used in arriving at these diametrically opposed hypotheses. The process by which several individually sub-infective virus injections attain infective concen-

tration in a plant has not yet been adequately explained. More work needs to be done on the subject. However, in passing, a report from Queensland is of particular interest in this regard despite the fact that experimental evidence from which the conclusions were drawn is not cited. The report of the director of the sugar experiment stations of Queensland for 1938 (194) contained a discussion of the susceptibility of certain cane varieties to Fiji disease. These varieties contain a certain amount of wild cane ancestry in their stock which provides desirable plant vigor and resistance to mosaic but confers high susceptibility to Fiji disease. The nature of the susceptibility is of unusual interest. "Whereas a stool of a resistant variety may require to be fed upon by say eight or ten infective insects [*Perkinsiella saccharicida*] before it will contract the disease, susceptible varieties may require only one insect per stool. When these insects are blown out of a diseased field by a high wind it is obvious that many stools will receive one hopper whereas very few would receive, say, five or six. Herein lies the danger of a susceptible variety in that it can become diseased when fed upon by a single infective insect."

If susceptibility and resistance of this type exists, it is strong evidence that the infective dose necessary to cause the disease varies with the variety of cane. Furthermore, the "mass action" hypothesis is necessary to account for infection by 5 to 10 leafhoppers on plants which fail to become infected when fed upon by but a single viruliferous leafhopper.

5. Two distinct viruses occurring together in a plant may be transmitted by a vector which is incapable of acquiring one of the component viruses when such occurs alone in a plant. Smith (216), during the past year, has reported that the rosette disease of tobacco is due to a complex consisting of two distinct viruses: vein-distorting virus and mottle virus. The vein-distorting virus cannot be transmitted mechanically but is transmitted by *Myzus persicae*. The mottle virus is easily transmitted mechanically but cannot be transmitted by *Myzus persicae* unless it occurs in the same plant which carries the vein-distorting virus. When this condition occurs the complex may be transmitted by the aphid at daily intervals for 20 days without again feeding on the virus source. Moreover, once the aphid has become infected with the virus complex, it may sometimes transmit only the mottle virus, at other times only the vein-distorting virus and sometimes the entire complex.

#### *Origin of "new" virus diseases.*

New virus diseases are being described each year in various parts of the world. Of interest to us here in Hawaii is the fact that less than a year ago a previously undescribed virus disease of papaya was discovered at Kailua, Oahu. This disease shows evidence of

becoming a serious threat to the papaya industry here if it continues to spread at its present rate. Whenever such a new virus appears on a commercial crop plant the question arises as to where it came from or how it originated. There are several possible answers but in the case of most new viruses the correct answer usually cannot be determined. Among the possible answers are the following:

1. The virus disease may have been introduced from some other part of the world where it had not been observed previously.
2. The virus may have been produced as a new disease for the first time in the host plant in which it is found. How this might take place has not been demonstrated. However, Johnson (104) in 1942 reported negative results from experiments he conducted to test a "viroplasm hypothesis." This postulates that extracts from healthy plants when inoculated into other healthy plants may result in some part of the protoplasm of the inoculum finding conditions compatible for growth and bring about an abnormality known as a virus disease in the host species.
3. The new virus may be a "mutant" strain of a virus already in existence, in which case the mutation may have altered the nature of the virus in relation to the host plant range, the insect vector or both. As evidence for this possibility, Jensen (102) published experimental results which he interpreted as evidence that yellow-mosaic viruses arise suddenly in plants infected with tobacco mosaic virus by some process similar to that of mutation.
4. The "new" virus may have existed previously in a different host plant, in which it may or may not have produced symptoms. It may have been confined to the original host or hosts for indefinite periods of time because, (a) a suitable vector was not previously available to transmit the virus out of the original host, or (b) though a vector was present which could transmit the virus among some hosts, no vector was previously present which was capable of disseminating the virus to susceptible hosts of economic importance.

Carter (36) has demonstrated that the operation of the situation described last is responsible for the freedom of pineapple from at least one virus to which it is definitely susceptible. This virus causes the common mosaic in *Commelina diffusa* (= *nudiflora* of Hawaiian authors<sup>2</sup>). He (36) showed that this virus is transmissible to young, tender pineapple plants by means of *Aphis gossypii* Glover, *Myzus persicae* and *Macrosiphum solanifolii*. Symptoms in pineapple closely resemble those produced by the yellow spot virus. Previous to Carter's work, pineapple had not been recorded as a

<sup>2</sup> The corrected identification of this common species of *Commelina* in Hawaii was provided by Dr. H. St. John of the University of Hawaii.

host for aphids. He found that the three species named would reproduce on very young seedlings but apparently are incapable of feeding satisfactorily on older pineapple plants. For this reason the virus is not likely to spread in the field. As pointed out by Carter, this demonstrates "that a plant may be highly susceptible to a virus but so unfavorable a host for a specific vector that natural infection is rare." It is probable that other viruses are also capable of causing serious injury to pineapple but lack vectors which can transmit them to this plant.

The only other insect-transmitted virus of pineapple is yellow spot, transmitted by *Thrips tabaci* (125). When yellow spot first appeared as a pineapple disease it was expected to be a major problem. However, as will be discussed more fully later, the disease is of minor importance because pineapple is not a preferred host of the vector.

Bennett (13) in 1944 reported a virus which needs only a suitable vector to make it a serious economic disease. This virus, named dodder latent mosaic (*Marmor secretum*), is symptomless and, until recently, was undetected in dodder, its normal host. It has now been shown by Bennett to induce a severe disease on cantaloupe, and a less severe disease on sugar beet, potato, celery, tomato and some other plants. The virus occurs naturally in dodder, *Cuscuta californica* Choisy, which grows on a desert shrub, *Eriogonum fasciculatum* Benth. in southern California. No symptoms are observable on dodder, but as this plant attaches itself to the crop plants listed, the virus is transmitted. It has been found to be juice transmissible, and, to a slight extent, is transmitted through the seed of *Cuscuta campestris*, one of three species of dodder which were shown to transmit it. No insect vector is known, but Bennett points out that with the introduction of an efficient vector, this virus might easily cause a serious disease on several cultivated plants.

## PART II. INSECT SPECIES OCCURRING IN HAWAII KNOWN TO TRANSMIT PLANT VIRUSES, WITH A LIST OF VIRUSES TRANSMITTED BY EACH

Insect species occurring in Hawaii and which have been reported to transmit plant viruses in some part of the world are listed in table 1. Opposite the species names are given the number of different viruses or distinct virus strains which have been reported transmitted by the respective species. In table 2, the names of the different viruses transmitted by each species are given with references to the literature on which each entry was based. Future research will undoubtedly show some of these viruses and strains to be synonyms.



Table 1. Insect species occurring in Hawaii, known to transmit plant viruses, and the number of virus diseases transmitted by each.

Species	Virus Diseases Transmitted
1. <i>Aphis citricidus</i> (Kirk.)	1
2. <i>Aphis ferruginea-striata</i> Essig	4
3. <i>Aphis gossypii</i> Glover	16
4. <i>Aphis maidis</i> Fitch	3
5. <i>Aphis medicaginis</i> Koch	1
6. <i>Aphis middletonii</i> Thomas	4
7. <i>Aphis rumicis</i> Linn.	13
8. <i>Brevicoryne brassicae</i> (Linn.)	8
9. <i>Cavariella aegopodii</i> (Scopoli)*	5
10. <i>Macrosiphum rosae</i> (Linn.)	4
11. <i>Macrosiphum solanifolii</i> (Ashmead)	30
12. <i>Myzus circumflexus</i> (Buckton)	16
13. <i>Myzus convolvuli</i> (Kalt.)*	6
14. <i>Myzus persicae</i> (Sulzer)	53
15. <i>Pentalonia nigronervosa</i> Coq.	4
16. <i>Rhopalosiphum pseudobrassicae</i> (Davis)	6
17. <i>Toxoptera aurantii</i> (B. de Fonsc.)	2
18. <i>Peregrinus maidis</i> (Ashmead)	1
19. <i>Perkinsiella saccharicida</i> Kirk.	1
20. <i>Draculacephala minerva</i> Ball	1
21. * <i>Orthezia insignis</i> Doug.	1
22. * <i>Pseudococcus citri</i> (Risso)	1
23. * <i>Pseudococcus maritimus</i> (Ehrhorn)	1
24. <i>Thrips tabaci</i> Lind.	2
25. <i>Pieris rapae</i> (Linn.)	1

\* This aphid has been listed in most literature as *Cavariella capreae* (Fab.).

\* If *M. pseudosolani* (Theob.) is a synonym of *M. convolvuli* (see footnote \*\*, p. 555), this species is reported to transmit 11 different virus diseases.

\* Virus transmission has been recorded in the literature, however, in the light of more recent work it is doubtful if these species actually are capable of serving as virus vectors.

Table 2. Insect vectors occurring in Hawaii with a list of viruses transmitted by each species. The virus strains listed are based primarily on the classification proposed by Holmes (96).

Virus	References
<b><i>Aphis citricidus</i> (Kirk.)</b>	
1. Pea mosaic virus	156
<b><i>Aphis ferruginea-striata</i> Essig</b>	
1. Celery calico virus	205
2. Celery mosaic virus, western	206
3. Celery crinkle-leaf mosaic virus (strain of western celery mosaic virus)	70
4. Poison-hemlock ringspot virus	71

Virus	References
<b><i>Aphis gossypii</i> Glover</b>	
1. Abacá mosaic virus .....	161
2. Bean mosaic virus .....	250
3. Cauliflower mosaic virus .....	215
4. Celery calico virus .....	205
5. Celery mosaic virus, western .....	206
6. Cowpea mosaic virus .....	142
7. Cucumber mosaic virus, typical strain .....	51, 52
8. Cucumber mosaic virus, lily mosaic strain .....	83, 96
9. Cucumber mosaic virus, lima bean mosaic strain .....	85
10. Cucumber mosaic virus, southern celery mosaic strain .....	53, 241
11. Lily mottle and tulip break virus group .....	28
(Marmor tulipae, amended)	
Lily coarse mottle virus .....	
Tulip coarse break virus .....	
12. Lily yellow-flat virus (= lily rosette virus) .....	163
13. Onion yellow dwarf virus .....	54
14. Pea mosaic virus .....	156
15. Ornithogalum mosaic virus .....	209
16. Poison-hemlock ringspot virus .....	71
<b><i>Aphis maidis</i> Fitch</b>	
1. Cucumber mosaic virus, southern celery mosaic strain .....	241
2. Onion yellow-dwarf virus .....	54
3. Sugar cane mosaic virus .....	22, 84, 115
<b><i>Aphis medicaginis</i> Koch</b>	
1. Bean mosaic virus .....	250
<b><i>Aphis middletonii</i> Thomas</b>	
1. Cauliflower mosaic virus .....	215
2. Celery calico virus .....	205
3. Celery mosaic virus, western .....	206
4. Poison-hemlock ringspot virus .....	71
<b><i>Aphis rumicis</i> Linn.</b>	
1. Bean mosaic virus .....	63, 250
2. Broad bean mild mosaic virus .....	248
3. Celery mosaic virus, western .....	206
Lupin sore-shin virus (= pea mosaic virus) .....	43
4. Narcissus mosaic virus .....	18, 19
5. Onion yellow-dwarf virus .....	54
6. Pea mosaic virus .....	44, 169
7. Poison-hemlock ringspot virus .....	71
8. Potato leaf roll virus .....	165
9. Soybean mosaic virus .....	9
10. Spinach yellows virus .....	49
11. Sugar beet mosaic virus .....	96, 215
12. Sugar beet yellows virus (= Beta virus 4) .....	215
13. White clover mosaic virus .....	215
<b><i>Brevicoryne brassicae</i> (Linn.)</b>	
1. Bean mosaic virus .....	250
2. Cabbage mosaic virus .....	121
3. Cauliflower mosaic virus .....	228
4. Crucifer black ring virus .....	231
(Probably the same as cabbage ring necrosis virus of Bowden 9)	

Virus	References
5. Crucifer mosaic virus (= Brassica virus 4) (may be turnip mosaic virus) .....	215
6. Onion yellow-dwarf virus .....	54
7. Stock mosaic virus (mild and severe strains) .....	230
8. Turnip mosaic virus .....	229
<b>Cavariella aegopodii (Scopoli)</b>	
1. Carrot virus .....	224
2. Cauliflower mosaic virus .....	215
3. Celery mosaic virus, western .....	206
4. Pea mosaic virus .....	156
5. Poison-hemlock ringspot virus .....	71
<b>Macrosiphum rosae (Linn.)</b>	
1. Celery mosaic virus, western .....	206
2. Narcissus mosaic virus .....	19
3. Onion yellow-dwarf virus .....	54
4. Pea mosaic virus .....	156
<b>Macrosiphum solanifolii (Ashmead)</b>	
1. Bean mosaic virus (common) .....	63, 153, 186, 250
2. Bean mosaic virus (yellow) (= Phaseolus virus 2) .....	186
3. <i>Commelina diffusa</i> mosaic virus .....	36
4. Cowpea mosaic virus .....	142
5. Cucumber mosaic virus, typical strain .....	89, 90
6. Cucumber mosaic virus, southern celery mosaic strain .....	36
7. Cucumber mosaic virus, potato veinbanding strain .....	57, 113
(= potato virus "Y" = Solanum virus 2) .....	
8. Hyoscyamus virus III .....	237
9. Iris mosaic virus (probably the same as iris stripe, 9) .....	27
10. Lily latent virus .....	96
11. Lily coarse mottle virus (part of <i>Marmor tulipae</i> Holmes, amended) .....	28
12. Narcissus mosaic virus .....	18, 19
13. Ornithogalum mosaic virus .....	209
14. Passion fruit woodiness disease virus .....	154, 155
15. Pea mosaic virus .....	44, 156, 169
16. Pea enation mosaic virus .....	167, 170
17. Pepper mosaic virus of Puerto Rico .....	195
18. Potato mild mosaic virus (virus "A") .....	57
19. Potato "bigarrure" virus .....	233
20. Potato calico virus .....	188
21. Potato leaf roll virus .....	57, 105
22. Potato crinkle mosaic virus .....	57
23. Potato spindle tuber virus, typical strain .....	96
24. Potato spindle tuber virus, unmottled curly dwarf strain .....	96
Potato rugose mosaic (See No. 7 for insect-transmitted vein banding component of this virus complex)	
25. <i>Primula obconica</i> virus .....	210
26. Soybean mosaic virus .....	9
27. Sugar beet mosaic virus .....	92
28. Tobacco etch virus, severe strain .....	110
29. Tobacco mosaic virus from tomato .....	93
30. Tulip breaking viruses (color adding and color removing strains; part of <i>Marmor tulipae</i> , Holmes amended) .....	26, 28, 140, 141

Virus	References
<b><i>Myzus circumflexus</i> (Buckton)</b>	
1. Cauliflower mosaic virus .....	215
2. Celery calico virus .....	205
3. Celery mosaic virus, western .....	206
4. Celery crinkle-leaf mosaic virus (strain of western celery mosaic) .....	70
5. Cucumber mosaic virus, typical strain .....	89
6. Hyoscyamus virus III .....	237
7. Ornithogalum mosaic virus .....	209
8. Poison-hemlock ringspot virus .....	71
9. Potato mild mosaic virus (virus "A") .....	57
10. Potato veinbanding virus (= potato virus "Y") .....	57, 237
11. Potato crinkle mosaic virus .....	57
12. Potato leaf roll virus .....	57
13. Soybean mosaic virus .....	9
14. Tobacco etch virus, severe strain .....	110
15. Tobacco mosaic virus, typical strain .....	91
16. Tulip breaking virus .....	26
<b><i>Myzus convolvuli</i> (Kaltenbach)**</b>	
1. Celery calico virus .....	205
2. Celery mosaic virus, western .....	206
3. Celery crinkle-leaf mosaic virus (strain of western celery mosaic) .....	70
4. *Freesia mosaic virus .....	215
5. Narcissus mosaic virus .....	19
6. Poison-hemlock ringspot virus .....	71
<b><i>M. pseudosolani</i> (Theob.)**</b>	
1. Cucumber mosaic virus, typical strain .....	9, 89, 91
2. Potato leaf roll virus .....	59, 105, 152, 210, 212, 215
3. Soybean mosaic virus .....	9
4. Tobacco mosaic virus .....	89, 93
5. Tomato narrow leaf virus .....	42
<b><i>Myzus persicae</i> (Sulzer)</b>	
1. <i>Allium neapolitanum</i> mosaic virus .....	29
2. Bean mosaic virus .....	250
3. Cabbage mosaic virus .....	121
4. Cabbage ringspot virus (Brassica virus 1) .....	215
5. Cabbage ring necrosis virus .....	9
6. Carnation streak virus .....	107
7. Cauliflower mosaic virus .....	228
8. Celery calico virus .....	205
9. Celery mosaic virus, western .....	206
10. Celery crinkle-leaf mosaic virus (strain of western celery mosaic virus) .....	70
11. Cowpea mosaic virus .....	142
12. Crucifer black ring virus (may be a synonym of ring necrosis virus) .....	231

\*\* Since according to Essig (60), *M. pseudosolani* (Theob.) is probably a synonym of *convolvuli*, the viruses transmitted by aphids under these names are listed under *convolvuli* but identified with the aphid names which appear in the literature. Essig (60) also indicates that *M. convolvuli* and *M. pseudosolani* may be synonyms of *M. solani* (Kalt.).

\* Transmission doubtful or in need of confirmation.

Virus	References
13. Cucumber mosaic virus, typical strain .....	88, 89, 90, 96, 237
14. Cucumber mosaic virus, southern celery mosaic strain .....	36, 96
15. Cucumber mosaic virus, potato veinbanding strain (= potato virus "Y") .....	57, 96, 113
16. Cucumber mosaic virus, lima bean mosaic strain .....	85, 96
17. Dahlia mosaic virus .....	96
18. *Datura virus 1 .....	215
19. Garlic mosaic virus .....	29
20. Hyoscyamus virus III .....	237
21. Henbane ( <i>Hyoscyamus niger</i> L.) virus .....	193
22. Iris mosaic virus (probably iris stripe virus of Bawden, 9) .....	27
23. Lettuce mosaic virus .....	3
24. Lily mottle virus group (part of <i>Marmor tulipae</i> , amended) .....	28
Lily coarse mottle virus	
Lily virulent coarse mottle virus	
Lily latent mosaic virus	
25. Lupin mosaic virus .....	156
Lupin sore-shin virus (= pea mosaic virus) .....	43
26. Onion yellow-dwarf virus .....	54
27. Ornithogalum mosaic virus .....	209
27a. Papaya ringspot virus (page 577)	
28. Passion fruit woodiness disease virus .....	154, 155
29. Pea enation mosaic virus .....	9
30. Pea mosaic virus .....	44, 156
30a. Peach mosaic virus***	
31. Pepper mosaic virus of Puerto Rico .....	195
32. Poison-hemlock ringspot virus .....	71
33. *Potato aucuba mosaic virus [probably] .....	96, 215
34. Potato "bigarrure" virus .....	233
35. Potato mild mosaic virus (= potato virus "A") .....	57
36. Potato crinkle mosaic virus .....	57
37. Potato tuber blotch virus (= potato virus "F" = Solanum virus 8) .....	9, 215
Potato rugose mosaic virus (See No. 15 for insect-transmitted vein banding component)	
38. Potato leaf rolling mosaic virus .....	57
39. Potato leaf roll virus .....	57, 105, 165, 215
40. Potato spindle tuber virus, typical strain .....	96
41. Potato spindle tuber virus, unmottled curly-dwarf strain .....	9, 96
42. Rape mosaic virus (may be turnip mosaic virus) .....	126
43. Soybean mosaic virus .....	9
44. Sugar beet mosaic virus .....	92
45. Sugar beet yellows virus .....	215
46. Stock mosaic virus (mild and severe strains) .....	230
47. Tobacco mosaic virus, typical strain .....	93, 96
48. Tobacco etch virus (mild and severe strains) .....	110
49. Tobacco rosette virus complex .....	93
Vein-distorting virus	
Mottle virus (only when combined with vein-distorting virus)	
50. Tulip breaking viruses 1 and 2 (color removing and color adding viruses, part of <i>Marmor tulipae</i> , amended) .....	26, 28, 140, 141
51. Turnip mosaic virus .....	229

\* Transmission doubtful or in need of confirmation.

\*\*\* Daniels, L. B. 1945. The peach mosaic disease. Science 101:87-88.

Virus	References
<b><i>Pentalonia nigronervosa</i> Coquerel</b>	
1. Abacá bunchy top virus .....	160, 161
2. Banana bunchy top virus .....	128
3. *Banana mosaic virus [probably] .....	129
4. *Cucumber mosaic virus, southern celery mosaic strain .....	96
<b><i>Rhopalosiphum pseudobrassicae</i> (Davis)</b>	
1. Bean mosaic virus .....	250
2. Cauliflower mosaic virus .....	228
3. Celery mosaic virus, western .....	206
4. Onion yellow-dwarf virus .....	54
5. Pea mosaic virus .....	156
6. Stock mosaic virus (mild and severe strains) .....	230
<b><i>Toxoptera aurantii</i> (Boyer de Fonscolombe)</b>	
1. Citrus "little leaf" virus .....	215
2. Lemon ribbing virus .....	40
<b><i>Peregrinus maidis</i> (Ashmead)</b>	
1. Corn mosaic virus .....	39, 84, 115
2. Corn stripe virus (may be corn mosaic virus) .....	7, 217, 221
<b><i>Perkinsiella saccharicida</i> Kirkaldy</b>	
1. Sugar cane Fiji disease virus .....	150, 158
<b><i>Draeculacephala minerva</i> Ball</b>	
1. Pierce's vine disease virus .....	67
<b><i>Pseudococcus citri</i> (Risso)</b>	
1. *Tobacco mosaic virus .....	164
<b><i>Pseudococcus maritimus</i> (Ehrhorn)</b>	
1. *Bean mosaic virus [doubtful] .....	58
<b><i>Orthesia insignis</i> [Listed as <i>insignia</i>] Douglas</b>	
1. * <i>Ephiphylum truncatum</i> virus [doubtful] .....	20
<b><i>Thrips tabaci</i> Lind.</b>	
1. Spotted wilt virus causing:	
a. Tomato spotted wilt .....	76, 187, 200, 213
b. Pineapple yellow spot .....	125, 200
c. Pea streak .....	124, 246
d. Cineraria streak .....	106
e. Tomato tip blight .....	96, 146, 157
2. *Tomato mosaic virus [doubtful] .....	47
<b><i>Pieris rapae</i> (Linn.)</b>	
1. Cabbage mosaic virus .....	121

\* Transmission doubtful or in need of confirmation.

**PART III. PLANT VIRUS DISEASES KNOWN OR REPORTED  
TO OCCUR IN HAWAII WITH SPECIAL REFERENCE  
TO THEIR TRANSMISSION BY INSECTS**

A list is presented of virus diseases which have been reported in the literature to occur in Hawaii. With a few exceptions no research work has been done in Hawaii on these viruses. Therefore experimental evidence is still lacking that the majority of the viruses reported from Hawaii are identical with viruses known by the same names in other parts of the world. Most of the work reviewed in this paper, on insect transmission of the diseases listed, was carried out in other regions. However, the majority of insect species recorded as vectors of these diseases occur in Hawaii. Furthermore, most of the diseases reported from Hawaii will probably prove to be identical with or related to diseases known by the same names in other areas. Knowledge regarding the identity of the vectors and of the factors which influence insect transmission of the diseases in question is therefore of fundamental importance to future studies undertaken in Hawaii.

**PLANT VIRUS DISEASES KNOWN OR REPORTED TO OCCUR  
IN HAWAII**

(Only those diseases indicated by an asterisk have been transmitted experimentally in Hawaii.)

Name	Page	Name	Page
1. Bamboo mosaic .....	600	23. Potato leaf roll .....	599
2. Banana mosaic .....	572	24. Potato leaf rolling mosaic ..	598
3. Bean mosaic .....	581	25. Potato mild mosaic .....	597
4. Canna mosaic .....	601	26. Potato mottle .....	597
5. *Commelina mosaic .....	571	27. Potato rugose mosaic .....	598
6. *Corn mosaic .....	559	28. Potato veinbanding disease	598
7. Crotalaria mosaic .....	585	29. Spinach blight .....	580
8. Crucifer mosaic .....	578	30. Soybean mosaic .....	582
9. Cucumber mosaic .....	567	31. *Sugar cane chlorotic streak	565
10. Dianella odorata Bl. mosaic	601	32. *Sugar cane mosaic .....	562
11. Eggplant mosaic .....	587	33. Tobacco mosaic .....	588
12. Hippeastrum mosaic .....	601	34. Tomato aucuba (yellow)	
13. Lettuce mosaic .....	581	mosaic .....	591
14. Lily mosaic .....	571	35. Tomato fern leaf .....	587
15. *Papaya mosaic .....	577	36. Tomato mosaic .....	588
16. *Papaya ringspot .....	577	37. Tomato mottle mosaic .....	590
17. Pea mosaic .....	583	38. Tomato spot necrosis .....	591
18. Peanut mosaic .....	586	39. *Tomato spotted wilt .....	591
19. Peanut rosette .....	585	40. Tomato tip blight .....	595
20. Pepper mosaic .....	586	41. Tomato streak .....	590
21. *Pineapple yellow spot .....	594	42. Tomato veinbanding disease	591
22. Potato crinkle mosaic .....	597		

## Corn Mosaic

The virus disease known as maize mosaic or corn mosaic is very destructive to corn in Hawaii. If several crops are grown in close succession, as is frequently the case in Hawaii, the disease incidence becomes very high, sometimes involving over 50 per cent of the plants. This results from the development of a high population of infective leafhoppers many of which move to the new corn plantings.

Much of the pertinent work which has been done on the relation of insects to this disease has been carried out in Hawaii. However, both the disease and the relation of the vector, *Peregrinus maidis*, to the disease need further careful investigation.

The first published description of corn mosaic was that of Weston (245) in 1917. However, Kunkel (114) in 1921 stated that the presence of the disease and its destructive nature in Hawaii were recognized by Dr. H. L. Lyon as early as 1914. During the first ten years after corn mosaic was reported in the literature, the opinion prevailed generally that, because of the similarity of the symptoms, this disease would probably prove to be due to the same virus that caused sugar cane mosaic. The fact that sugar cane mosaic is transmissible to and from corn by means of *Aphis maidis*, was a complicating factor in clarifying the identity of the disease and its vector.

Under the name of corn mosaic, Brandes (23) in 1920, discussed a virus disease which occurred in sorghum and corn in Puerto Rico and the southern United States. He described the disease and reported experiments in which *Aphis maidis* transmitted it from mosaic sorghum to healthy corn and from infected corn to healthy corn. It is now obvious that he was dealing with sugar cane mosaic virus and not that of true corn mosaic.

Kunkel (115) in 1922 reported insect transmission of sugar cane mosaic and corn mosaic under the heading "Insect transmission of yellow stripe disease." He was the first to report transmission of corn mosaic by the corn leafhopper, *Peregrinus maidis*. His experiments indicated that the virus could be transmitted from corn to corn by *Peregrinus maidis* but could not be transmitted from corn to cane. Furthermore, he reported that the corn leafhopper failed to transmit the cane disease from cane to cane. The stripe disease in cane and mosaic of corn were at that time thought to be due to the same virus. It was not until 1927 that reports were published suggesting the distinct identity of the viruses, one of which caused mosaic or stripe symptoms in sugar cane, corn and other plants (and is transmitted by *Aphis maidis*) and the other (transmitted by *Peregrinus maidis*) which caused symptoms in corn but does not infect cane.

Kunkel (118) in 1927 reported that the corn leafhopper, *Peregrinus maidis*, occurring in North Carolina was unable to transmit



the virus of sugar cane mosaic of the United States to corn. He concluded, "this suggests that the destructive mosaic of corn prevalent in Hawaii is distinct from sugar cane mosaic and from the mosaic of corn occurring in Louisiana and other Southern States."

In the same year, Stahl (217) described a stripe disease of corn in Cuba and stated it was not identical with sugar cane mosaic. It was transmitted by *Peregrinus maidis*.

In 1928 Hadden (84), working on insect transmission of sugar cane mosaic in Hawaii reported: "Two insects have transmitted the disease: the corn aphid from various grasses to cane and other grasses; and the corn leafhopper, *Peregrinus maidis*, from corn to corn and in one case from corn to Striped Tip cane." Hadden considered it probable that the single case of disease transmission from corn to cane by *Peregrinus maidis* was an accident. Stahl's conclusion that corn mosaic and sugar cane mosaic were distinct was cited by Hadden who concluded: "Corn aphid may transmit one kind of mosaic. Corn leafhoppers may transmit a different kind of mosaic. Or both of these insects may transmit more than one kind of mosaic."

The identity and relationships of the corn viruses reported from different parts of the world have not been adequately established despite the fact that they have *Peregrinus maidis* as a common vector. Holmes (96) calls them all maize mosaic virus (*Marmor zaeae*). However, Bawden (9) in 1943 listed corn mosaic and maize stripe as separate diseases.

The corn mosaic or corn stripe disease reported from parts of the world other than Hawaii may be summarized as follows:

1. *Cuba*. Stahl (217) in 1927 reported transmission of corn stripe disease by means of *Peregrinus maidis* but not by *Aphis maidis*.

2. *Trinidad, B.W.I.* Briton-Jones (30) in 1933 reported a severe stripe disease of corn in Trinidad. He considered this to be distinct from corn mosaic reported from Hawaii and other parts of the world except that reported by Stahl from Cuba. Later the same year Baker (7) transmitted this disease at Trinidad from maize to great millet by means of *Peregrinus maidis*. Briton-Jones (30) stated that the width of the stripes produced on diseased plants was dependent largely on the number of *Peregrinus maidis* which fed on the affected plants. "Those heavily infested with the insect develop broader stripes than those lightly attacked." This observation has not been reported by any other writer. Furthermore, the vector experiments reported in Briton-Jones' paper were inconclusive. The fertility and condition of the soil seemed to have more effect on symptom production in the plants than did the *Peregrinus maidis* which were caged on them, although some transmission by insects apparently occurred. The observation was also made by this author

that "*Peregrinus maidis* is very common on young maize until the tassel is produced when the insect leaves the plant." In Hawaii such a migration from the plant has not been observed, and the corn leafhopper may be found in large numbers on corn plants until after the mature plants are beginning to dry up.

3. *Puerto Rico*. White stripe disease of corn in Puerto Rico was described by Cook<sup>5</sup> in 1936 to correspond with the symptoms reported from Cuba and Trinidad.

4. *East Africa*. Storey (221) in 1932 reported the presence of a maize disease closely resembling maize streak. However, it was found to be transmitted by *Peregrinus maidis* and not by *Cicadulina mbila*, the vector of maize streak. He suggested the possibility that it might be identical with the stripe disease of Cuba.

Although transmission of one or more corn viruses by means of *Peregrinus maidis* has been reported by Kunkel (115) and Hadden (84) in Hawaii, Stahl (217) in Cuba, Baker (7) in Trinidad, and Storey (221) in Africa, no data on the incubation period of the virus and its retention in the insect were published until Carter's paper (39) appeared in 1941. His experiments demonstrated that the incubation period of the corn mosaic virus in *Peregrinus maidis* normally varies from 11 to 29 days. However, in some instances much shorter incubation periods occurred. Some were estimated as low as four days. In all cases this short incubation period occurred in insects which were genetically closely related. Carter cited the report by Storey (222), that the ability of *Cicadulina mbila* to transmit maize streak is controlled by genetic factors and suggested that the short incubation periods in *P. maidis* in a few genetically related individuals "may also be due to genetically controlled factors affecting permeability of the insect's tissues. If such a relationship could be conclusively proved, it would surely establish incubation period as a function of the physiology of the vector rather than of the virus." This is a direction in which important fundamental work could be done on a basic problem which is still unsolved.

Carter kept some leafhoppers on a diet of 2 per cent sucrose solution for seven days during part of the incubation period of the virus in the leafhopper. In these individuals the minimum incubation period was 13 days, thus demonstrating that the normal insect diet of juice from living plants is not essential for normal incubation of the virus in the vector.

Carter's work demonstrated that *P. maidis* can acquire the virus as nymphs or adults. The percentage of individuals which acquired and transmitted the virus in several different test groups varied from 9 to 57 per cent. Most individuals, but not all, which transmitted the disease, infected an unbroken series of several plants

<sup>5</sup> Cook, M. T. 1936. Phloem necrosis in the stripe disease of corn. Jour. Agr. Univ. Puerto Rico 20:685-688.

when transferred at 2-day intervals. Retention of the virus by the leafhoppers varied considerably. The maximum retention, as shown by transmission to a succession of healthy plants, was 48 days after feeding on the disease inoculum.

There is need for more extensive research on the role of *Peregrinus maidis* in disseminating corn mosaic. As yet it has not been determined how long a leafhopper must feed on a diseased plant before it can acquire the virus. It should also be determined whether the leafhopper must feed on certain portions of the leaves (such as areas showing the mottle symptom) in order to acquire the virus. In the experiments reported by Carter, the leafhoppers acquired the virus from leaf tissue. It would also be of interest to know if the vector can obtain the virus from stem tissue as well.

Carter (39) pointed out that some factor exists which complicates the acquisition of the virus by the vector and this is apparently responsible for the low percentage of individuals which become vectors under some conditions.

In view of the varying symptoms which have been observed on plants affected with corn mosaic and the fact that Wellman (242) transmitted southern celery mosaic virus to corn by means of *Aphis gossypii*, the possibility exists that this virus also may be found in corn plants diagnosed as being affected with corn mosaic virus. Wellman stated that corn plants so affected were stunted and in some other respects were remarkably similar to plants infected with Cuban corn stripe.

### Sugar Cane Mosaic

Mosaic has been one of the most important diseases of sugar cane in the world because of its injury to the plant and because of its cosmopolitan distribution. The almost universal occurrence of one of its insect vectors, *Aphis maidis*, has undoubtedly been responsible in large measure for the greater economic importance of this disease from a world standpoint than some of the other virus diseases of cane whose vectors are more restricted in their distribution. Although mosaic was reported first from Java, Brandes and Matz (25) consider it probable that it originated in New Guinea which is part of the general region where sugar cane itself is believed to have originated.

In Hawaii, mosaic was first noted by Lyon in 1908. It was then called yellow stripe disease. Although extensive research was conducted in Hawaii between 1910-1914, the results were not published until 1921 (127). Since that time the disease has been under investigation in Hawaii as well as in other parts of the world.

Brandes (22) in 1920 was the first to report transmission of sugar cane mosaic by means of insects. He transmitted the disease with *Aphis maidis* from mosaic sorghum to healthy cane. In the same year he (23) transmitted mosaic from sorghum and corn to

healthy corn. He reported this as mosaic disease of corn, but in the light of our present knowledge concerning the vectors of sugar cane mosaic and corn mosaic it is apparent that the virus he worked with was that of sugar cane mosaic.

Before the separate identity of corn mosaic and sugar cane mosaic had been established, Kunkel (115) in 1922 reported experiments in Hawaii on the transmission of "yellow stripe disease" in which aphids and leafhoppers were used as the test insects and corn and cane as the test plants. Apparently the series of corn plants used as inoculum contained both cane mosaic and corn mosaic because Kunkel stated "*Aphis maidis* transferred from mosaic corn plants to healthy cane plants transmitted yellow stripe disease." And, "the corn leafhopper (*Peregrinus maidis*) transmitted corn mosaic from corn to corn, but failed to transmit it to cane from corn or from cane to cane."

In the same report Kunkel stated that the sugar cane aphid, *Aphis sacchari* Zehnt., and the sugar cane leafhopper, *Perkinsiella saccharicida*, failed to transmit the virus from diseased to healthy cane.

Hadden (84) in 1928 published the results of experiments conducted in Hawaii on the transmission of sugar cane mosaic by insects. He also reported observations on the ecology of *Aphis maidis* which was found to reproduce on 34 species of grasses. Both sugar cane mosaic and corn mosaic were treated in this study but they were spoken of as the same disease in some of the discussion. However, Stahl's (217) announcement, published in 1927, that corn stripe disease in Cuba was distinct from sugar cane mosaic was cited by Hadden who therefore concluded it was possible that the mosaics transmitted in Hawaii by *Aphis maidis* and by *Peregrinus maidis* might be due to distinct viruses. During the course of this investigation *Aphis sacchari*, *Perkinsiella saccharicida*, *Stictocephala festina* (Say), *Draeculacephala mollipes* (Say)<sup>6</sup> and *Tetranychus evsiccator* Zehnt. failed repeatedly to transmit sugar cane mosaic.

Ingram and Summers (99, 100, 101) in 1936, 1937 and 1938, announced the discovery of two additional aphid vectors of mosaic in the southern United States. These are *Hysteronneura setariae* (Thomas) and *Toxoptera graminum* (Rond.). The former species was found to be the most common aphid on cane between 1930 and 1937 and although a much less efficient vector than *Aphis maidis*, it apparently was responsible for much of the rapid spread of mosaic because *Aphis maidis* was scarce in most areas. *Toxoptera graminum* was not found as generally as *Aphis maidis* but was common in some fields.

Tate and Vandenberg (226) in 1939 described experiments which demonstrated that the aphid *Carolinaia cyperi* Ainslie transmitted mosaic in Puerto Rico. Of 192 plants exposed to viruliferous

<sup>6</sup> The species in question may have been *D. minerva*. See footnote, p. 471.

*C. cyperi*, 31.2 per cent became diseased. In similar experiments *Aphis maidis* infected 34.5 per cent of 200 test plants. *C. cyperi* was found to breed on nut grass, *Cyperus rotundus*, in and around the cane fields. According to St. John and Hosaka (196) this grass is common in some parts of Hawaii. Exploratory experiments with *Aphis rumicis*, *Macrosiphum rudbeckiae* (Fitch) and *Aphis nerii* B. de Fonsc. were also reported by Tate and Vandenberg. Nine experiments with each of the first two species were all negative, but a single plant out of four exposed to *A. nerii* developed mosaic symptoms. Although this cannot be considered a demonstration of transmission by *nerii* it does mark this species as one which should be tested more extensively.

Costa Lima (50) in 1926 reported the belief that *Thrips minuta* var. *puttemansi* Costa Lima was a vector of sugar cane mosaic in Brazil. However, this has not been demonstrated experimentally.

It has been well established that there are several different strains of sugar cane mosaic. Summers (225) reported four in Louisiana in 1934 and Martin (134) in 1939 stated that 10 strains or sub-strains are known to exist, some of which are more virulent than others. Cuttings with mosaic were sent from Hawaii to Washington, D.C. where their virulence was compared with that of other mosaic strains. The Hawaiian strain was found relatively difficult to transmit and when infection did occur the symptoms were considered mild. This is a fortunate circumstance for Hawaii. Although mosaic was once a serious cane disease in Hawaii, it is now considered to cause only minor losses. This has come about through the development of cane varieties which are resistant to the mosaic. However, the danger of mosaic again becoming a serious problem in Hawaii is always imminent. A cane variety resistant to one strain of mosaic is not necessarily resistant to all of the other strains. Mr. Martin, of the H.S.P.A. Experiment Station, has informed the writer<sup>7</sup> that the POJ-36 cane variety is highly resistant to the mosaic virus strain occurring in Hawaii, but it is not resistant to the common mosaic strain of Louisiana. Both strains are transmitted by *Aphis maidis*. It would be easily possible for infective aphids to reach Hawaii alive by means of fast planes and, if allowed to escape, they could introduce the more virulent mosaic strain into Hawaiian cane fields where further dissemination could be accomplished by the *Aphis maidis* already established here. The fact that cane varieties which are resistant to some of the other mosaic strains have been developed, does not mitigate the danger. Such resistant varieties may not prove to be as satisfactory under Hawaiian conditions as are those now in use or in the process of development in Hawaii. Furthermore, converting large areas over to new varieties within a short period of time, would involve difficult problems and serious monetary losses. Such a sudden change might be necessary in the

<sup>7</sup> Personal communication.

event a virulent strain of the virus became established here. The rigid quarantine imposed in Hawaii on sugar cane cuttings of newly imported varieties has played a major part in preventing the introduction of new insects and diseases of this crop.

In most regions where sugar cane mosaic occurs, it has been possible to transmit the different virus strains by means of *Aphis maidis*. However, Storey<sup>8</sup> in 1936 announced that in Natal he found a cane variety, "Agaul," which showed typical mild mosaic symptoms, and which was assumed to harbor the prevalent mosaic virus. Attempts to transfer mosaic from "Agaul" by mechanical means or by *Aphis maidis* were unsuccessful. Furthermore, he found that there was no dissemination of the disease in the field in East Africa and concluded, "Either this mosaic pattern is a varietal character—a highly improbable conjecture—or the Agaul virus is different from the common sugar cane virus. This Agaul variety was imported to Natal from India . . ." The history of mosaic in India contains many variable results, according to Storey, including, at times, failure of transmission by *Aphis maidis*.

### Sugar Cane Chlorotic Streak

This disease was first noted in Java in 1928. In 1930 Martin (131) reported its occurrence on several cane varieties in Hawaii. He gave the disease the name chlorotic streak and this name has become generally accepted throughout the world. Martin (135) reported transmission of the disease by means of hypodermic needle inoculation in one experiment. Negative results were obtained in all other trials. The disease can be killed in cane cuttings by subjecting them to hot water treatment for 20 minutes at 52° C. (132).

Martin (133) stated that the cause of the disease had not been determined, but that in many ways it resembled the virus type of disease more than the fungus or bacterial type. Holmes (96) included it in his handbook of viruses. Abbott and Sass (2) in 1945 stated that the demonstrated fact of insect transmission "gives strong indication that it is caused by a virus."

Host plants other than sugar cane have not been demonstrated, but Martin (132) reported that symptoms similar to those of chlorotic streak were found to occur on Job's tears, *Coix lachryma-jobi*, and on elephant grass, *Pennisetum purpureum*, which are often found growing in close proximity to sugar cane.

*Insect transmission.* Martin (132, 133) in 1936 and 1938 reported that no positive results had been secured in Hawaii from experiments conducted to determine the identity of an insect vector of chlorotic streak. The following species were used in these experiments: the cane aphid, *Aphis sacchari*; the corn leaf aphid, *Aphis maidis*; the sugar cane leafhopper, *Perkinsiella saccharicida*; the

<sup>8</sup> Storey, H. H. 1936. Proc. Fifth Congr. Internatl. Soc. Sugar Cane Technol. (Brisbane) 1935: 108-116.

green sharpshooter, *Draeculacephala mollipes*; the pink sugar cane mealybug, *Trionymus sacchari* (Ckll.); the onion thrips, *Thrips tabaci*; and the sugar cane stalk mite, *Tarsonemus spinipes* Hirst.

In 1942 Abbott and Ingram (1) reported transmission of chlorotic streak by means of the leafhopper *Draeculacephala portola* Ball in the southern United States. They obtained transmission to only 25 out of 490 plants tested. These results indicate that *D. portola* is a relatively inefficient vector or else that the experimental transmission was complicated by a factor which has not yet been determined. These authors pointed out that the genus *Draeculacephala* has been reported in Hawaii, Puerto Rico, Colombia and Louisiana where chlorotic streak is reported to spread under natural conditions, but not in Java where the disease was first described.

Until recently *D. portola*, which feeds on sugar cane in the Gulf States, has been misidentified as *D. mollipes*. True *mollipes* presumably occurs primarily in the northeastern United States and is not a sugar cane pest in Florida or Louisiana (1).

Martin (133) stated that natural spread of the disease occurs in certain regions in Hawaii. In both Hawaii and Australia, the disease is most prevalent in localities where rainfall is heavy. In view of this record of field spread we can assume that a vector of the disease probably is at large in Hawaii.

The report by Abbott and Ingram on transmission of chlorotic streak by *D. portola* and the confusion which has existed regarding the identity of some species in this genus are pertinent to the situation here. Until recent years the "sharpshooter" in Hawaii, which sometimes occurs on sugar cane, was identified as *D. mollipes* (247). Recently<sup>9</sup> it has been announced that both *D. minerva* and *D. mollipes* occur here; *minerva* may be the more common of the two species. In view of the results obtained by Abbott and Ingram in Louisiana it is probable that insect transmission of chlorotic streak in Hawaii can be demonstrated by using the *Draeculacephala* species we have here, even though *D. portola* is not one of them. This premise is supported by the fact that phylogenetic relationships are known to exist among the vectors of several virus diseases. Frazier (67) in 1944 reported nine species of leafhopper vectors for Pierce's vine disease in California. All nine species occur in the Amblycephalinae, a subfamily in which every species (including *D. minerva*) thus far tested has proven to be a vector. At the same time, many species of leafhoppers in other subfamilies have been tested and not one has been found to transmit the grape disease. Similar vector-virus relationships occur within the genera *Cicadulina* and *Perkinsiella* which include vectors of maize streak disease and Fiji disease of sugar cane, respectively. The three known species of vectors of maize streak all occur within the genus *Cicadulina*. *Perkinsiella* includes two species which have

<sup>9</sup> See footnote, p. 471.

been shown to transmit Fiji disease. In addition, Mungomery and Bell (150) and Pemberton (185) have pointed out that a third species must be the vector in Fiji. Furthermore, others of the 21 species listed by Pemberton (185) as occurring in the genus are probably vectors in other localities.

In view of the low percentage of chlorotic streak transmission obtained by means of *D. portola* in Louisiana it is probable that long series of experiments would have to be run with the main suspect species before negative evidence could eliminate them from the suspect group.

### Cucumber Mosaic

Two of the cucumber mosaic strains discussed below are known in the literature by several different names. They are:

1. Cucumber mosaic virus, typical strain, (*Marmor cucumeris* var. *vulgare* Holmes).

Synonyms: Common cucumber mosaic virus, Cucumber virus 1; Cucumis virus 1; Spinach blight virus.

2. Cucumber mosaic virus, southern celery mosaic strain (*Marmor cucumeris* var. *commelinae* Holmes).

Synonyms: Southern celery mosaic virus; Celery virus 1.

The properties of the cucumber mosaic virus occurring in Hawaii, and its symptoms on various hosts have not been studied. It has been assumed that we have the typical strain or common cucumber mosaic. This is probably true in view of the fact that we also have a spinach blight which agrees in general with the description of the spinach blight on the mainland known to be due to common cucumber mosaic. In addition we have in Hawaii "fern leaf" of tomato, a disease induced by common cucumber mosaic virus in tomato.

It is now apparent, however, that we have more than one variety or strain of cucumber mosaic virus in Hawaii. Although it has not been definitely proved, there is evidence that the southern celery mosaic strain of cucumber mosaic, or a related strain, occurs in Hawaii. This virus was studied by Doolittle and Wellman (53, 239, 240, 241, 242, 243, 244). It was responsible for severe losses in the celery growing areas of Florida and was found to spread to celery from *Commelina nudiflora* which grows around the fields as a weed. When first investigated, this disease was assumed to be common cucumber mosaic. However, Wellman (240) in 1934, after a comparison of the symptoms on various hosts with symptoms produced by other viruses, concluded that the virus infecting celery and *Commelina nudiflora* in Florida was distinct from the strain known as common cucumber mosaic. He gave it the name southern celery mosaic (Celery virus 1). Part of the evidence Wellman presented as a basis for his conclusions was the fact that southern celery mosaic was transmissible to watermelons which,



he stated, are immune to common cucumber mosaic virus. In addition, *Commelina nudiflora* has not been found susceptible to common cucumber mosaic whereas it is the most important weed host of southern celery mosaic. The differential susceptibility to strains of cucumber mosaic virus shown by watermelon and *Commelina* has a bearing on the identity of the virus strains occurring in Hawaii. Parris (175) in 1936 recorded mosaic on watermelon (*Citrullus vulgaris*) in Hawaii. If this mosaic was caused by one of the cucumber mosaic viruses, it is probably one more closely related to southern celery mosaic than to common cucumber mosaic in the light of Wellman's report (240) that watermelon is immune to the latter virus strain. The few records of watermelon mosaic referred to by Walker (234) in 1933 were listed as being due to cucumber mosaic without differentiation of strains. *Commelina nudiflora* has been found to be the main weed host of southern celery mosaic virus in Florida. What has been considered to be the same plant, *Commelina diffusa* Burm. (= *nudiflora* of Hawaiian authors), in Hawaii was observed by Kunkel (114) in 1921 and Hadden (84) in 1928 to carry a mosaic disease. In 1935 Carter (34) transmitted *Commelina* mosaic to pineapple by mechanical inoculation, and in 1937 he (36) transmitted it to pineapple by means of *Aphis gossypii*, *Myzus persicae*, and *Macrosiphum solanifolii*. Southern celery mosaic has been reported to be transmitted by the same species of aphids and in addition by *Aphis maidis*.

According to Price (192) the mosaic symptoms produced in the Hawaiian *Commelina diffusa* are similar to those produced by southern celery mosaic in *nudiflora* of Florida. He concluded that the viruses are probably related but that further proof is needed. In 1941 Price (192) reported the results of studies he conducted with a yellow strain and a green strain of mosaic in *Commelina diffusa* from Hawaii which he received through Dr. Carter. He found that these strains, though closely related, were not equal in their ability to infect dicotyledonous hosts when inoculated mechanically. Moreover, the symptoms produced on species of *Nicotiana*, *Cucumis sativus* L. and *Zinnia elegans* by the yellow and green strains of Hawaiian *Commelina* mosaic were similar to, but distinguishable from, those of both common cucumber mosaic and the southern celery mosaic strain of cucumber mosaic virus on the same hosts. Since the symptoms of *Commelina* mosaic in Hawaii were reported to vary from a brilliant yellow mottling to a mild green mottling, Price recommended referring to these strains as yellow and green variants of cucumber mosaic virus pending more comprehensive study of them under local Hawaiian conditions.

In view of the circumstances presented above, both the common cucumber mosaic virus (*Marmor cucumeris* var. *vulgare*) and the cucumber mosaic virus, southern celery-mosaic strain (*Marmor cucumeris* var. *commelinae*) will be treated in this paper.

## Cucumber Mosaic Virus, Typical Strain

(*Marmor cucumeris* var. *vulgare*)

**Synonyms:** Cucumber virus 1; Cucumis virus 1; Common cucumber mosaic virus; Spinach blight virus; Tomato "fern leaf" virus; possibly also banana bunchy top virus.

**Symptoms:** This virus frequently causes yellowish green systemic mottling on cucumber. The plants become stunted, the leaves are small and may be curled or otherwise distorted. Fruits may also be mottled and misshapen (96). Parris (177) stated that the most dependable symptom is the bunching of the leaves at the tips of the vines.

**Host plants.** The host plant range of this virus is very wide. Holmes (96) listed 34 families of plants in which susceptible species occur. Thirty-two species are found in Cucurbitaceae alone. Among common cultivated plants listed by Holmes (96) as sometimes seriously affected are, cucumber, celery, spinach, tobacco, pepper and tomato. In spinach the cucumber mosaic virus causes "spinach blight" (see "Spinach blight") and in tomato it causes "fern leaf." Parris (177) listed the following plants in Hawaii as susceptible to cucumber mosaic virus: *Beta vulgaris* (beet), *Spinacea oleracea* (spinach), *Citrullus vulgaris* (watermelon), *Cucumis melo* (muskmelon), *C. sativus* (cucumber), *Cucurbita pepo* (pumpkin), *Nicandra physaloides* (apple of Peru), *Petunia hybrida* (petunia), *Solanum carolinense* (horsenettle), *S. nigrum* (nightshade) and *Viola* sp. (violet). On the basis of the list of susceptible hosts reported by Holmes, the group listed by Parris represents only a small portion of the number in Hawaii which should be susceptible hosts.

In addition to the diseases reported above caused by cucumber mosaic virus, Holmes (96) stated that this may also be the virus which causes bunchy top disease of bananas in Australia.

**Insect transmission.** Doolittle and Walker (51, 52) in 1920 and 1925 demonstrated transmission of this virus by means of *Diabrotica vittata*, *D. duodecimpunctata* and *Aphis gossypii*. Hoggan (88, 89, 90) in 1929 and 1930 transmitted cucumber mosaic virus by means of *Myzus persicae*, *Myzus pseudosolani* (*M. pseudosolani* probably = *M. convolvuli*), *Myzus circumflexus* and *Macrosiphum solanifolii*.

No studies have been reported on the transmission of common cucumber mosaic in Hawaii by means of insects. However, this is one of our most common virus diseases and it consistently takes a heavy toll of many plantings in Hawaii. Frequently the majority of cucumber plants in a field become infected before the crop has matured. Since the melon aphid, *Aphis gossypii*, is by far the most common aphid on cucurbits in Hawaii, it is probable that most of the spread in nature is due to this species. *A. gossypii* is also one

of our most common aphids on a large number of non-cucurbit host plants. It is thus able to maintain a relatively high population in nature during most of the year with the result that new plantings of cucurbits are seldom able to remain free from infestation for more than a short time.

There are varieties of cucumber which are resistant to cucumber mosaic, but their adaptability to Hawaiian conditions has not yet been adequately investigated and the varieties commonly planted here are susceptible to the disease.

### Cucumber Mosaic Virus, Southern Celery Mosaic Strain

(*Marmor cucumeris* var. *commelinac*)

*Synonyms:* Celery virus 1, celery mosaic virus.

*Host plants.* Holmes (96) discussed the susceptible species as follows: "*Commelina nudiflora* L.; *Apium graveolens* L., celery; *Capsicum frutescens* L., pepper; *Musa cavendishii* Lamb and *M. sapientum* L., banana; *Zea mays* L., corn; and many other vegetables, grasses, and weeds, altogether 91 species in 23 families. So far as known, the host range of this strain and of the type strain are alike." Although the host range of this strain and the type strain are alike in general, the susceptible and insusceptible species tested are not the same for both strains as was demonstrated by Wellman (240) in 1934, and discussed earlier in this paper.

*Disease symptoms.* In *Commelina nudiflora*, celery and peppers the leaves become mottled and in the case of the latter two plants stunting and distortion of the plant occurs (96). In banana, the new leaves are stunted and often streaked with yellowish and green regions which frequently become necrotic. The stunted plants acquire a rosette-like appearance which in some respects resembles bunchy top of banana (241).

In corn, (*Zea mays*) Wellman (242) reported "the celery virus causes a stripe disease of maize in Florida very similar to but not identical with the white stripe of maize in Cuba. After numerous experiments it was evident that the celery-virus stripe on maize in Florida is transmitted by aphids but not by *Peregrinus maidis*, which Stahl (217) found was the vector of Cuban white stripe."

Mosaic diseases in banana and corn, in many respects resembling those reported above, occur in Hawaii and are discussed more fully under "Banana Mosaic" and "Corn Mosaic."

*Insect transmission.* Doolittle and Wellman (53) in 1934 reported transmission of southern celery mosaic by means of *Aphis gossypii*. In the same year Wellman (241) announced transmission of this virus to 2 banana plants by means of *Aphis maidis* and to 13 of 15 Lady Finger banana plants exposed to viruliferous *Aphis gossypii*. Although both test plants exposed to *Aphis maidis* contracted the disease, it would be desirable to test this aphid on a much longer series of plants in order to confirm its ability as a

vector of this virus and eliminate the possibility that transmission may have been due to the presence of more than one aphid species in the test population. This precaution is particularly appropriate for *Aphis maidis* because this species has not been found to be as versatile a vector of plant viruses as are some species of aphids. Only two other virus diseases (sugar cane mosaic and onion yellow dwarf) have been shown to be transmissible by *Aphis maidis*.

In addition to the aphid vectors of southern celery mosaic virus listed above, Carter (36) in 1937 reported he had received a personal communication from Wellman stating that *Myzus persicae* and *Macrosiphum solanifolii* are also vectors of this virus.

Holmes (96) listed *Pentalonia nigronervosa* as a vector of southern celery mosaic. This species has not been demonstrated to transmit the virus in the United States. Its inclusion by Holmes apparently results from the fact that southern celery mosaic was shown by Wellman (241) to be transmissible to banana in which it produced symptoms similar to bunchy top of banana, a disease known to be transmitted by *Pentalonia nigronervosa* in Australia. However, that these diseases are identical has not as yet been demonstrated.

### Commelina Mosaic

The virus causing common mosaic in *Commelina diffusa* in Hawaii is a strain of cucumber mosaic. Carter (36) reported transmission of this virus to pineapple by means of *Aphis gossypii*, *Myzus persicae* and *Macrosiphum solanifolii*. (For a more complete discussion of Commelina mosaic see "Cucumber Mosaic," p. 567.)

### Lily Mosaic

The only reference encountered in the literature to lily mosaic in Hawaii is one by Parris (175), who in 1936, listed a mosaic on *Lilium longiflorum*.

The identity, host and vector relationships are not known for the lily mosaic reported from Hawaii. Until recent years it was believed that the lily virus diseases (lily mosaic and yellow flat) were distinct from similar diseases occurring in tulips and some other plants. In 1935 Wellman (244) found lily to be among the plants susceptible to southern celery mosaic virus. Price (191) in 1937 found that leaves of zinnia plants infected with a strain of lily mosaic virus were immune from infection with cucumber mosaic virus. On the basis of these tests and the similarity of cucumber mosaic symptoms in lily to those of lily mosaic in lily, he concluded that lily mosaic virus should be classified in the cucumber mosaic virus group. The fact that *Aphis gossypii* was known to be vector of both lily mosaic (83) and southern celery mosaic (240) contributed to this conclusion. Another lily disease, known as yellow

flat, was considered by Price (191) to be due to a virus distinct from that causing lily mosaic.

In accordance with the conclusions of Price on the relationships of lily mosaic, Smith (215) placed lily mosaic under *Cucumis* virus 1. Holmes (96) in his classification of viruses erected the name cucumber mosaic virus, lily mosaic strain (*Marmor cucumeris* var. *lilii*) to include part of the lily mosaic complex of viruses.

McWhorter (143) in 1935 stated that the virus which causes "breaking" (color-adding and color-removing) in tulips is transmissible to lilies in which it produces a disease indistinguishable from lily mosaic.

Brierley and Smith (28) in 1944 reported the results of experiments in the United States on the properties, host range and vector relations of three lily mottle viruses, (which they assigned to the tulip virus group) as well as comparative data on tulip viruses 1 (color removing) and 2 (color adding) of McWhorter (144). Unfortunately the extensive investigations reported by Brierley and Smith do not include comparison of the viruses in question with the mosaic induced in lily by cucumber mosaic virus as reported by Price (191). Most of the host studies were in *Lilium*. They concluded that the five viruses studied (coarse mottle virus, virulent coarse mottle virus, latent virus, tulip virus 1 and tulip virus 2) might justify designation as separate virus entities. However, to avoid confusion in nomenclature they placed them all in *Marmor tulipae* of Holmes which must then be amended to include color-removing as well as color-adding virus. Brierley and Smith grouped them as three subspecies: tulip color-removing subspecies, tulip color-adding subspecies and lily mottle subspecies. As thus defined, *Marmor tulipae* was found by Brierley and Smith (28) to be transmissible by sap and by *Aphis gossypii*, *Macrosiphum solanifolii* and *Myzus persicae*. In addition "*Aphis fabae*"<sup>10</sup> was found to transmit the tulip color-adding and tulip color-removing strains. The previously reported additional vectors of these latter strains were *Anuraphis tulipae* (B. de Fonsc.) (141) *Macrosiphum solanifolii* and *Myzus persicae* (139, 140).

### Banana Mosaic

In 1921 Kunkel (114) mentioned a mosaic on banana in Hawaii. No further reference to a banana virus here has been recorded in the literature. On October 3, 1945 the author noted what appeared to be virus symptoms of a mosaic type on the leaves of several young Chinese banana plants (*Musa cavendishii*) at Waipahu,

<sup>10</sup> The identity of the species in question is uncertain. Smith (215) in 1937 listed *Aphis fabae* Scop. as a synonym of *Aphis rumicis* Linn. Jones (109) in 1942 stated that *fabae* and *rumicis* are distinct species and can be distinguished easily on morphological grounds. He also concluded that in England *fabae* is a polyphagous species but that *rumicis* colonizes only on plants belonging to the genus *Rumex*. In a letter to the writer dated January 4, 1946, Professor E. O. Essig stated that the occurrence of *fabae* in the United States has not been definitely established.

Oahu. The oldest leaves appeared to be normal but the youngest four to six leaves were streaked with light and dark green areas in a linear pattern along the secondary veins of the lamina. As the leaves became older the symptoms appeared to become more conspicuous and there was a tendency for the chlorotic streaks to become necrotic. Marginal chlorosis occurred on some leaves to a slight extent. The diseased plants were stunted and the more mature affected leaves drooped to the ground.

Considerable variation occurred in the chlorotic and light green streaks which occurred on the leaves. The streaks on some leaves were narrow while on others larger portions of the lamina were light green to yellowish in color and appeared as a mottle or blotch or as irregular, longitudinal chlorotic areas. The light green streaks were usually not continuous, but were interspersed with areas of darker green tissue. Occasionally yellowish areas appeared diamond shaped on the lamina. Sometimes such areas had a green center and in other instances the entire affected area was yellow or light green.

On October 10, 1945, in company with Dr. F. G. Holdaway and Mr. J. W. Hendrix of the University of Hawaii, the writer found, on the Campbell banana plantation at Mokuleia, Oahu, a single half grown banana plant which exhibited mosaic symptoms such as described above. Symptoms occurred only on the two youngest leaves. There is some evidence that within the last two years Mr. Campbell removed a block of several hundred plants which were similarly affected. On October 14, 1945 the writer noted several young banana plants at Laie which showed streaking and chlorosis similar to that found at Waipahu. On October 23, 1945 Mr. J. W. Hendrix and the writer examined a 2-acre planting of bananas in Manoa Valley in which approximately 10 per cent of the plants showed mosaic symptoms. The symptoms were again found to vary considerably in their pattern, ranging from relatively mild mosaic symptoms of interspersed light and dark green areas, to conspicuous elongate streaks and mottles which appeared to become necrotic on some of the older leaves. These streaks or chlorotic patches also occasionally appeared diamond shaped. Enough plants, both healthy and infected, were present to see the effects the disease may have on a commercial planting. Partial strangulation of the new leaves in the center of the pseudo-stem with resultant malformation of the leaves was noted in some plants. Most of the diseased plants were found to be stunted. Those which apparently became infected while very young had made practically no growth. Young suckers being produced from diseased stools were also diseased in most instances.

The writer visited this planting again November 25, 1945. Healthy plants had produced near-mature bunches of fruits, but

most of the diseased plants were still dwarfed and making little growth. During this visit it was noted that considerable mosaic-diseased *Commelina diffusa* was growing in the vicinity of the field. Furthermore the diamond shaped mosaic symptoms on many of the leaves of *Commelina* closely resembled the symptom pattern on some of the affected banana leaves.

In view of Kunkel's report of banana mosaic in 1921 and a report by Mr. Carpenter (quoted below) that a banana mosaic has been noted sporadically in the intervening years, it is probable that this disease ordinarily does not spread with great rapidity or regularity within banana plantings. However, it is possible that at times severe damage may have been produced in localized areas without being brought to the attention of the public.

The report by Wellman (241) of transmission in Florida of the southern celery mosaic strain of cucumber mosaic from *Commelina nudiflora* to banana by means of *Aphis gossypii* and *Aphis maidis* is of particular interest. The symptoms produced in banana by this virus included stunting of the leaves and of the plant as a whole, and chlorotic streaks on the leaves. In some instances the streaks became necrotic. The plants were reported to have acquired a rosette-like appearance which resembled bunchy top of bananas in Australia. The stunting of the plants and the streaking and necrosis of the leaves resemble symptoms observed on banana in Hawaii.

In this connection a report by Mr. C. W. Carpenter of the Pathology Department of the Hawaiian Sugar Planters' Association Experiment Station is very pertinent. In a letter dated October 23, 1945 addressed to the writer Mr. Carpenter stated: "A mosaic of the Chinese banana is not uncommon on Oahu; about 10 years ago the banana mosaic was very prevalent at Mokuleia after cucumbers were interplanted. The latter were seriously affected with mosaic."

The above reports by Wellman and Carpenter, when considered with the report by Price (192) that Hawaiian *Commelina* mosaic is very closely related to both common cucumber mosaic and southern celery mosaic, suggest the possibility that Hawaiian banana mosaic may be due to one or more strains of cucumber mosaic which occur in *Commelina*, cucumber, and probably other host plants in Hawaii.

Although the banana mosaic observed in Hawaii has not been demonstrated to be a virus, the symptoms strongly suggest that such is the case. Furthermore, similar symptoms in banana in other parts of the world have been shown by experimental transmission to be due to viruses. If mosaic in Hawaii proves to be a virus its identity and relationship to other similar viruses should be determined. The symptoms observed in Hawaii resemble in some respects several of the symptoms described for other virus-induced

banana diseases. These diseases (Banana heart-rot, infectious chlorosis, and bunchy top) will be discussed briefly although they are not known to occur in Hawaii.

*Banana heart-rot or infectious chlorosis* (due to *Musa virus 3* of Smith). This disease has not been extensively studied. However, Magee (129) in 1930 reported its occurrence in New South Wales and thought it was transmitted by the banana aphid, *Pentalonia nigronervosa*. This disease causes yellowing and mottling of the foliage throughout the year and rotting of the heart leaf and central portion of the pseudo-stem during the winter. The rotting extends down into the corms and usually kills the plants. The yellowing symptoms are variable, but usually take the form of continuous or discontinuous streaks extending from the midrib to the margin of the leaf. These streaks vary in width from very narrow to more than  $\frac{1}{2}$  inch. The leaf symptoms resemble, in a general way, those found on diseased plants in Hawaii. A heart-rot stage in Hawaii has not yet been observed. This disease was not reported as being widespread in New South Wales, but Magee stated that if it were to become widespread it might be a greater threat to the banana industry than banana bunchy top.

*Brazilian infectious chlorosis of banana*. Wardlaw (236) in 1935 discussed a type of infectious chlorosis observed on banana in the state of Sao Paulo, Brazil. This he considered closely related to the banana heart-rot disease of Australia. The leaf symptoms were described as "light chlorotic linear areas extending as irregular, broken, sometimes anastomosing, lines or stripes from the midrib to the leaf margin." In contrast to the symptoms observed in Hawaii, the leaf mottle of the Brazilian disease tends to be masked on the older leaves. The disease has been shown to be systemic and is transmitted to the daughter suckers. This disease apparently does not injure the plant and diseased stools produce normal bunches year after year, except that mosaic mottling may occur on the fruit skin. No plants have been found in which rotting of the central leaf and the core of the pseudo-stem occurred as reported for the heart-rot disease in Australia.

The leaf symptoms of the disease in Brazil vary with environmental conditions. Mottling may fade noticeably or disappear completely from plants making rapid growth as a result of hot, wet weather or fertilizing. During the cold dry season when little growth takes place the leaf mottle develops maximum intensity.

Wardlaw (236) reported experiments in which the banana aphid, *Pentalonia nigronervosa*, failed to transmit the disease.

A disease of bananas, believed by Wardlaw (236) to be the same as that reported from Brazil, has also been observed in Trinidad, West Indies, for several years. A similar disease of banana reported by Ogilvie (162) from Bermuda in 1928 is also believed by



Wardlaw (236) to be probably the same as the disease reported from Brazil. In Bermuda, however, the disease has a slight dwarfing effect on the plants.

### Banana Bunchy Top

Magee (128) in 1927 reported that since its appearance in Australia in 1913 bunchy top disease has ruined the banana industry in several areas. It has also caused considerable damage in Fiji (where it is believed to have originated), and in Ceylon and Egypt (128).

The general symptoms of the disease are described by Magee (128). "The leaves of a badly infected plant are bunched together at the apex of the plant to form a rosette. Owing to the failure of the leaf stalks to elongate, the leaves stand more erect than normal. Infected plants are markedly stunted, there being little growth in height once the plant has taken the disease."

The first definite symptoms of the disease appear in the newly unfurled center leaf on which irregular, nodular, dark green streaks about 0.75 mm. wide appear along the secondary veins of the leaf lamina. Leaves produced subsequently may show whitish streaks along the secondary veins of the leaf blade before the leaf has unfurled. When these leaves unroll they bear dark green streaks along the secondary veins and dots or lines on the midrib and petiole. The leaves may also be somewhat stunted, slightly chlorotic, and the margins of the lamina may be wavy and rolled upwards slightly.

Due to strangulation or leaf congestion at the apex of the pseudostem, diseased plants often fail to throw the bunch or it may get partly out and be left standing erect or at right angles to the pseudo-stem. The fruit of such bunches is usually stunted.

Magee (128) transmitted this virus by means of the banana aphid, *Pentalonia nigronervosa*. Plants infected by means of this aphid developed primary symptoms in an average of 25 days.

Banana bunchy top virus was reported by Magee (128) to be transmissible to abacá or Manila hemp (*Musa textilis*) by means of *Pentalonia nigronervosa*. The symptoms reported by Magee in Manila hemp differ somewhat from those reported by Ocfemia for this disease in the Philippine Islands. Furthermore, the virus in the Philippines has not been found to be transmissible by *Pentalonia nigronervosa* from Manila hemp to banana. Of unusual interest is the report by Ocfemia and Buhay (160) in 1934 that in transmitting the virus from abacá to abacá in the Philippines, *Pentalonia nigronervosa* must feed on the inoculum for 12 hours in order to acquire the virus. In addition to this time the virus requires an incubation period of from 24 to 48 hours in the aphid vector before it can be transmitted to a healthy plant.

### Papaya Mosaic

Parris (178, 182, 184) in 1939, 1940 and 1941 discussed a new disease of papaya which was discovered at Waialua and Lualualei, Oahu, in July 1937. In 1939 Parris (179) reported mechanical transmission of the disease to healthy plants in over 75 per cent of the tests conducted. He concluded that a virus was probably the causative agent. During the first 2 years after the discovery of the disease in Hawaii, papaya mosaic caused losses ranging from 6 to over 30 per cent in several large plantings (179). However, since 1939 diseased plants have been observed only occasionally.

Symptoms of the disease were described by Parris (179). Diseased plants are stunted and the foliage is yellowed. The petioles of diseased leaves are bent downwards at their point of attachment to the stem. "Linear, darker-green than normal, slightly raised, hydrotic-like streaks may be present on any portions of the main stem of a diseased plant, and on the petioles of yellowed leaves. . . . The streaks vary from  $\frac{1}{8}$  to 1 inch in length and from  $\frac{1}{32}$  to  $\frac{3}{8}$  inch in width. . . . Diseased leaves abscise rapidly, and 4 to 6 weeks after initial symptoms only a few badly distorted and undersized leaves remain clustered at the top. The leaves developed prior to symptom expression persist as a fringe around the base of the plant."

Parris also reported that "When a diseased papaya plant is decapitated or death of the growing point takes place naturally, new growth develops from the lower portions of the stem. It has been observed that the new shoots may all be healthy, or some be healthy and some diseased."

Holdaway and Look (95) in 1940 reported negative results from preliminary experiments conducted to determine an insect vector of papaya mosaic. The species tested included: *Aphis gossypii*, *A. medicaginis*, *A. maidis*, *Macrosiphum gei* (= *solanifolii*), *Myzus persicae*, *Empoasca solana* DeLong, *Nysius coenosulus* Stål, and *Thrips tabaci*.

Virus diseases of papaya have been reported from other parts of the world. Parris (178) considered it possible that the mosaic of Hawaii is identical with a disease in Queensland called "yellow crinkle" by Simmonds (208).

The mosaic of papaya in Hawaii is apparently distinct from the papaya mosaic reported from China by Ho and Li (87) in 1936.

### Papaya Ringspot

Lindner *et al.* (123) in 1945 reported the presence in Hawaii of a previously undescribed papaya disease which appeared to be due to a virus. This disease, designated as papaya ringspot, was discovered by Dr. R. C. Lindner at Kailua, Oahu, in March 1945.

The disease is characterized by a mottle or mosaic pattern in the younger leaves resulting from irregular areas of leaf tissue

which are of a lighter green color than that of the rest of the leaf. The mosaic symptoms in the foliage are usually very conspicuous during the winter months, but mild during the summer. Diseased plants show retardation of growth and are weakened and killed more readily by adverse environmental conditions than are normal plants.

The most striking and reliable symptom of papaya ringspot disease appears in the fruits as they reach the ripening stage. Yellow rings with green centers are produced on the fruit surface. These rings vary in size from  $\frac{1}{8}$  to  $\frac{3}{4}$  of an inch in diameter and may be circular or irregular in outline. The number of rings on a single fruit varies from a few to over 150.

Experiments conducted by the writer at Honolulu demonstrate that *Myzus persicae* is a vector of the ringspot virus. The disease was transmitted to 55 of 90 test plants exposed to viruliferous aphids between April 1 and July 31, 1945. After inoculation, symptoms developed in rapidly growing papayas in from 11 to 21 days.

### Crucifer Virus Diseases

The relationships of some of the virus diseases which are found infecting cruciferous plants have not yet been adequately elucidated. Research work reported during recent years indicates that several viruses or virus strains are involved.

The identity, properties, host range and manner of dissemination of the virus diseases which occur in cruciferous plants in Hawaii are at present unknown. Kunkel (117) in 1924 was the first to report mosaic on Chinese cabbage, *Brassica pekinensis* (Lour.). Parris (177) in 1938 described the general types of symptoms which occur on some cruciferous plants here and cited the work done by Schultz (202) in 1921 as the source of his information on physical properties and manner of transmission. Parris (177) stated that mosaic had been seen in Hawaii on mustard, radish, Swiss chard, Chinese cabbage and turnip. In the same year he recorded (176) mosaic on daikon (*Rhaphanus* sp.) in Hawaii. Martin (138) in 1943 also reported mosaic on daikon in Hawaii. Frazier (68) reported mosaic as being among the most serious diseases of spoon cabbage and green mustard in Hawaii.

During recent years investigations have shown that several different virus diseases occur in cruciferous plants, and that most of these viruses have several plant hosts in common. The collective term, crucifer mosaic, therefore, loses meaning when the host range, symptoms, properties and methods of transmission are studied. Hoggan and Johnson (94) in 1935 described a crucifer virus transmissible by *Brevicoryne brassicae* and *Myzus persicae*. Tompkins (228) in 1937 described a mosaic disease of cauliflower which he considered distinct from the other diseases which had previously been reported from crucifers. He reported transmission by means

of the aphids *Brevicoryne brassicae*, *Rhopalosiphum pseudobrassicae* and *Myzus persicae*. "The host range included 51 vegetable varieties, 3 ornamentals and 5 weeds, all belonging to the family Cruciferae." In discussing Tompkins' cauliflower mosaic virus (*Brassica virus 3* of Smith) Smith (215) in 1937 stated that Severin had informed him that this disease had been transmitted experimentally by the following aphids:

Species already occurring in Hawaii:

- Brevicoryne brassicae*—Cabbage aphid
- Rhopalosiphum pseudobrassicae*—False cabbage aphid
- Myzus persicae*—Green peach aphid
- Myzus circumflexus*—Lily aphid
- Aphis gossypii*—Melon aphid
- Aphis middletonii*—Erigeron root aphid
- Cavariella aegopodii* (= *caprae* Fab.)—Yellow willow aphid

Species not recorded from Hawaii:

- Aphis graveolens* Essig—Celery leaf aphid
- Aphis apigraveolens* Theob.—Celery aphid
- Rhopalosiphum melliferum* Hottes—Honeysuckle aphid

Tompkins (229) in 1938 described a mosaic of turnip and other plants which was readily transmitted by *Myzus persicae* and *Brevicoryne brassicae*. In the same year Tompkins and Thomas (232) described a mosaic disease of Chinese cabbage (*Brassica pe-tsai*) which was prevalent in central California. The host range of this virus included cauliflower, turnip, cabbage, radish, and mustard. The insect vectors were found to be the same as for turnip mosaic. In 1938 Tompkins, *et al.* (231) described a virus disease of cabbage and other crucifers which they named black ring. Again the vectors were shown to be *Myzus persicae* and *Brevicoryne brassicae*.

In 1939 Larson and Walker (121) described a destructive mosaic disease of cabbage in Wisconsin. All cruciferous plants tested were found to be susceptible to the disease. In addition, Swiss chard and spinach were among the noncruciferous hosts determined. The virus was found to be transmissible by juice inoculation. Three insects, *Myzus persicae*, *Brevicoryne brassicae* and the cabbage worm *Pieris rapae* were shown to be vectors of the virus. The discovery of the cabbage worm as a vector of a virus is of singular interest because it is one of the few records of a lepidopterous larva transmitting a plant virus. It was found necessary for the aphid vectors reported to feed on a diseased plant for  $\frac{1}{2}$  hour in order to acquire the virus. They were then capable of retaining the virus long enough to infect four different healthy plants consecutively without a second feeding on the inoculum. The feeding period on each successive test plant was 1 hour. It is of interest that this

virus can be transmitted by mechanical means and by a chewing insect and yet requires at least  $\frac{1}{2}$  hour of feeding by the aphid vectors in order to acquire the virus. Furthermore, once infective, the aphids retain the ability to infect four consecutive healthy plants over a period of 4 hours.

Although the relationships of the crucifer viruses reported above need further clarification, the evidence is increasing that several different but related viruses occur in these plants. Tompkins and Thomas (232) stated in 1938 that on the basis of symptoms, Chinese cabbage mosaic, cauliflower mosaic and turnip mosaic can easily be differentiated on Chinese cabbage, winter colma cabbage and purple top white globe turnip.

Walker, *et al.* (235) and Pound, *et al.* (127) in 1945 showed that a strain of turnip virus 1 of Hoggan and Johnson (94) and a strain of cauliflower virus 1 of Tompkins (228) may occur together in cabbage with the characteristic symptoms of each being apparent and varying in intensity as the air temperatures vary. Turnip virus and cabbage black ring virus symptoms were found to increase in intensity with increasing air temperature. This was in contrast to the cauliflower virus group in which symptom severity increased as the air temperature was decreased. When a strain of turnip virus or a strain of black ring virus occurred in cabbage together with a strain of the cauliflower virus "the resulting disease reaction was more severe than that produced by either virus alone."

The need for research on crucifer viruses in Hawaii is obvious. At least one of these viruses occurs here and very possibly there are more than one. Most of the known insect vectors of crucifer viruses have already become established in the Territory. This fact increases the hazard which accompanies the inevitable introduction into Hawaii of other viruses not already established here.

### Spinach Blight

Parris (177) in 1938 reported blight as a virus disease of spinach in Hawaii. Symptoms were described as including mosaic, mottling, yellowing and distortion of the leaves and stunting of the plant. The disease was reported by Parris to cause severe losses in Hawaii occasionally.

Although several viruses have been reported to induce disease symptoms in spinach, blight is usually considered to be due to cucumber mosaic virus. Hoggan (92) in 1933 discussed the symptoms produced in spinach by cucumber mosaic virus, sugar beet mosaic virus and tobacco ringspot virus. Hoggan's paper also reported transmission of cucumber mosaic virus to spinach by means of *Myzus persicae* and *Macrosiphum solanifolii*.

Parris cited Hoggan's paper as a reference but listed *Aphis rumicis* as a vector in addition to the two species recorded by Hoggan. The writer has failed to find any other report in the literature

of *Aphis rumicis* as a vector of spinach blight. The report by Parris may have been based upon the fact that Hoggan had transmitted sugar beet mosaic virus to spinach. *Aphis rumicis* is a vector of sugar beet mosaic but was not used in the transmission experiments reported by Hoggan. According to Hoggan, the symptoms of sugar beet mosaic in spinach are distinct from those produced by cucumber mosaic.

### Lettuce Mosaic

Parris (177) in 1938 reported that a lettuce mosaic occurred in a high percentage of plantings in Hawaii and resulted in considerable loss. Symptoms of the disease reported from Hawaii include yellowish discoloration and a mosaic pattern of the leaves, rugosity of the leaf blade, and stunting of the plants. Mosaic prevents heading in head lettuce varieties.

Holmes (96) listed the following plant species as susceptible to lettuce mosaic virus (*Marmor lactucae*): Compositae—*Senecio vulgaris* L., groundsel; *Sonchus asper* Hoffm., prickly sow-thistle. Leguminosae—*Lathyrus odoratus* L., sweet pea, *Pisum sativum* L., pea.

*Transmission.* Ainsworth and Ogilvie (3) in 1939 reported that experiments conducted in England resulted in lettuce mosaic transmission by *Myzus persicae* to 15 out of 33 plants and by *Macrosiphum solanifolii* to 1 out of 23 plants. The latter species was reported as being the most common lettuce aphid in southwestern England. The virus has also been shown to be juice transmissible and in addition is one of the viruses that is carried through the seed of diseased plants.

No insect transmission studies have been reported from Hawaii.

### Bean Mosaic

A bean mosaic virus (*Marmor phaseoli* of Holmes) has been shown to be transmissible to several species of *Phaseolus*, to *Vicia faba* L., *V. lathyroides* L. and *Lespedeza striata* Hook. and Arn. (79), all within the family Leguminosae. It is not transmissible to garden pea or sweet pea.

The symptoms of bean mosaic virus vary considerably depending on age and variety of the host and on environmental conditions. Holmes (79) states "first leaves to be affected are crinkled, stiff, chlorotic; later leaves show chlorotic mottling; leaf margins often rolled down."

This disease seriously reduces the yield of beans in many bean-growing areas. An unidentified bean mosaic occurs in Hawaii. Parris (177) discussed it briefly and its presence in Hawaii has also been noted by Martin (136, 137) in 1941 and 1942. According to a personal communication from members of the Departments of Vegetable Crops and Pathology, University of Hawaii Agricultural

Experiment Station, bean mosaic is of moderately common occurrence in Hawaii, but usually does not cause serious crop losses.

*Insect vectors.* The first record of bean mosaic transmission by means of insects was reported in 1922 by Nelson (153) who found that the potato aphid, *Macrosiphum solanifolii*, served as a vector. He failed to transmit the virus by means of *Empoasca fabae* (Harris). Elmer (58) in 1925 believed the mealy bug, *Pseudococcus maritimus*, was a vector, but this has not been well established although Fajardo (63) in 1930 reported transmission of bean mosaic by means of an undetermined species of mealy bug in addition to *Aphis rumicis*, *Myzus persicae* and *Macrosiphum solanifolii*. In 1936 Zaumeyer and Kearns (250) reported studies conducted in Colorado where they obtained transmission with 10 of 11 species of aphids tested and failed to transmit the virus by means of 10 species of insects other than aphids. The aphids found to transmit bean mosaic were: *Aphis gossypii*, *Aphis medicaginis*, *Aphis rumicis*, *Brevicoryne brassicae*, *Rhopalosiphum pseudobrassicae*, *Myzus persicae*, *Macrosiphum solanifolii*, *M. pisi* (Kalt.), *Aphis spiraecola* Patch, *Hyalopterus atriplicis* (Linn.) and *Macrosiphum ambrosiae* (Thomas). The first six species listed are known to occur in Hawaii at the present time.

The aphid which failed to transmit bean mosaic was *Neothomasia populicola* (Thos.) collected from poplar. With the exception of *Aphis medicaginis*, which infected 44 per cent of the plants on which it was tested, all of the demonstrated aphid vectors transmitted the disease to over 50 per cent of the test plants. *Rhopalosiphum pseudobrassicae* infected 100 per cent of the test plants upon which it fed.

### Soybean Mosaic

Martin (136, 138) in 1941 and 1943 reported the occurrence of a soybean mosaic at Kailua and Waipio, Oahu. These are the only records of this disease in Hawaii and its identity is not known. A soybean mosaic was encountered in Indiana in 1920 (75). It was described as severely stunting and distorting the plants. The petioles and internodes were shortened, the leaflets were small, misshapen and puckered with dark green puffy areas along the veins. The pods were stunted, flattened and more sharply curved than normal. Diseased plants remained green longer in the season suggesting delayed maturity. The virus was transmitted mechanically and by seed but no insects were tested as vectors. The disease was confined largely to the side of a field near a planting of garden beans which were affected with a mosaic disease. This suggests the possibility that it may have been a bean virus which spread to soybean in this instance.

Smith (215) reported that soybean is susceptible to pea enation mosaic virus (= *Pisum virus 1*). The symptoms were described as

"a mottled dark and light green mosaic pattern." Zaumeyer (249) in 1938 listed soybean as a susceptible host of a pea streak virus which was carried by *Macrosiphum pisi*. However, the disease symptoms on soybean were not described.

### Pea Mosaic

The exact identity of the pea mosaic which occurs in Hawaii has not been established, since no transmission experiments involving the disease have been reported from Hawaii. Parris (177) listed pea mosaic in Hawaii. His description of some of the mottle symptoms produced on garden pea (*Pisum sativum*) and sweet pea (*Lathyrus odoratus*) are characteristic of common pea mosaic virus (*Marmor leguminosarum* Holmes = *Pisum virus 2* of Smith). However, the reference (166) cited by Parris regarding the vector applies to a distinct virus known as pea enation mosaic virus (*Marmor pisi* Holmes).

In addition to the two pea viruses mentioned above, there have been at least three mosaic diseases of pea described as new in recent years (249), and several virus-induced pea streaks (46, 249). Furthermore, pea is a susceptible host for several other virus diseases which were described originally from other plant species (especially in the Leguminosae) in which they are more commonly encountered in nature (124, 246, 251).

Chamberlain (44) in 1936 cited literature to the vectors of pea mosaic. According to this author the following vectors have been determined: *Macrosiphum pisi* (227), *Aphis rumicis* and *Rhopalosiphum viciae* (possibly = *A. rumicis*) (21), *R. fabae* (145), *Myzus persicae* (98) and *Macrosiphum solanifolii* (168). In New Zealand Chamberlain (44) transmitted a pea mosaic to several hosts by means of *Myzus persicae*, *Macrosiphum solanifolii*, and *Aphis rumicis*.

Osborn (169) in 1937 reported transmission of pea virus 2 (= pea mosaic virus, *Marmor leguminosarum* Holmes) by both nymphs and adults of *Macrosiphum pisi*, *M. solanifolii* and *Aphis rumicis*. Transmission was obtained by means of individual aphids as well as with larger numbers. These insects were shown to be able to acquire the virus during a feeding period of 5 minutes on diseased plants and were able to transmit the virus to healthy plants during a 5 minute period immediately following removal from the inoculum. None of the colonies retained the virus for more than 1 hour when fed continuously on a healthy plant. However, Osborn states, "when held without access to food, the bean aphid was shown to retain the virus for 5 hours, the pea aphid for 8 hours, and the potato aphid in one instance for 24 hours."

### Pea Enation Mosaic Virus (*Marmor pisi* Holmes)

It is not known definitely that pea enation mosaic disease occurs



in Hawaii. However, since some of the early symptoms on some varieties may be confused with those produced by common pea mosaic, it is possible that the enation disease occurs here. In view of this fact and because of the unusual insect vector-virus relationships involved, this disease will be discussed briefly. In addition to chlorotic mottling, this virus sometimes produces necrotic spots and enations on the lower surface of the leaves. Holmes (96) states that the pods become distorted and, in broad bean, striping as well as chlorotic spotting may occur on the leaves. Transmission experiments could easily yield information as to which virus occurs in Hawaii if there is only one, since pea enation mosaic virus produces symptoms on the pea varieties Perfection and Horal which are resistant to common pea mosaic, *Marmor leguminosarum* (96).

Bawden (9) lists *Myzus persicae* as a vector of pea enation mosaic virus but does not cite a reference to the publication which reported this aphid as a vector of the virus in question.

Osborn (166, 167, 168) demonstrated that pea enation mosaic virus is transmitted by the pea aphid, *Macrosiphum pisi*, and the potato aphid, *M. solanifolii*, but not by *Aphis rumicis*. Both aphid species were unable to infect healthy plants until after a period of virus incubation in the vectors. The duration of this period varied considerably, but averaged about 12 hours for both species. In two colonies of the pea aphid, held at 80° to 90° F., the incubation period of the virus in the aphids was not less than 4 nor more than 10 hours. At the other extreme, one of the colonies held on plants in a greenhouse in which the temperature varied from 64° to 70° F. showed an incubation period of not less than 72 nor more than 96 hours.

Both the pea aphid and the potato aphid were shown to retain the virus for extended periods of time after becoming infected. Infective colonies of pea aphids, when transferred daily to a succession of healthy plants, retained the virus for 29 days. Single aphids were shown to retain the virus for 23 days. Potato aphids that acquired the virus from diseased broad bean, *Vicia faba*, retained the virus for as long as 21 days while feeding continuously on insusceptible tomato plants.

Since practically all viruses transmitted by aphids require no incubation period in the vector or but a very brief one, and since such viruses are lost by their vectors soon after feeding on healthy plants, the definite and sometimes extended incubation period of pea enation virus in the pea and potato aphids, and the ability of these aphids to retain the virus for long periods of time, is of great interest. A large number of aphid species have not been tested as possible vectors of this disease. However, in view of the vector-virus relationship demonstrated, it is probable that the number of species capable of transmitting this virus will be small.

### Crotalaria Mosaic

Illingworth (97) in 1931 noted in a pineapple field in Hawaii, Crotalaria plants which showed marked mosaic and yellowing symptoms. "Leaf mosaic" of Crotalaria was listed by Martin (136) in 1941 from Kohala, Hawaii. The writer has observed a conspicuous mosaic on the same plant at Kailua, Oahu during 1945.

The identity of the Crotalaria mosaic in Hawaii is not known.

Johnson and Lefebvre (103) in 1938 reported a mosaic disease which appeared in the Crotalaria nursery at Arlington, Virginia. It was described as "a disease characterized by a general stunting of the plants, by mottling, blistering, and malformation of the leaves, and by abnormally stimulated lateral branching or witch's brooming." This virus was transmitted by juice inoculation to broad bean, *Vicia faba*. No transmission by insects was reported. These authors refer to a report published in 1927 indicating that a witch's broom disease of Crotalaria was found in Java which was considered to be of a virus nature and assumed to be spread by insects.

It is possible that Crotalaria mosaic virus is a strain of one of the cucumber, bean or pea viruses which include several legumes among their susceptible host species.

### Peanut Rosette

Nothing is known of peanut rosette in Hawaii except that such a disease occurs here. Martin (136, 137) listed it as occurring at Kailua, Oahu in 1941 and in several places on Oahu in 1942.

Holmes (96) classified a peanut rosette virus as *Marmor arachidis*.

Storey and Bottomley (223) in 1928 reported that rosette is a destructive disease of peanuts in South Africa and that a similar disease occurs in tropical Africa, Java and India. It was reported to be transmissible by grafting but not through the seed or by mechanical inoculation. The plant may be severely altered by the virus due to chlorosis, stunting and malformation of the leaflets. Sometimes the entire plant may appear as a tuft of small curled leaves. The first evidence of infection was described by Smith (215) as a faint mottling of the youngest leaves. Plants showing distinct mosaic symptoms usually are not severely stunted.

Three distinct graft-transmissible strains of the virus were reported by Hayes (86) to exist in the Gambia. Chlorosis rosette caused the young leaves to be flaccid and develop yellow patches which later appeared as a light green mottle. Green rosette produced no chlorosis and the leaves were darker in color than normal. Rosette type No. 3 did not affect the normal color of the leaves but caused them to be smaller and thicker than normal. The stems were much thickened and each branch curved in a clockwise direction. Smith (215) considers it possible that Hayes' chlorosis rosette and green rosette may be due to two distinct viruses since both may

be put in the same plant without exhibiting any cross immunity. Hayes' report also indicated that the presence of weeds or close spacing of the plants resulted in less spread of rosette. The reason for this effect was not determined but it was suggested that with increased vegetative ground cover there was less evaporation from the soil resulting in more dew formation which may have affected the habits of the insect vector or the physiology of the plant.

Insect transmission of rosette was accomplished by means of *Aphis laburni* Kalt. (= *A. leguminosae* Theob.) in South Africa, but 13 species of leafhoppers failed to transmit the disease (221, 223).

Since the disease is reported to be non-transmissible through the seed or by juice inoculations, and since the only demonstrated vector, *Aphis laburni*, is not known to occur in Hawaii, it is probable that additional species are capable of transmitting the virus. In Hawaii *Aphis medicaginis* and *A. rumicis* would be logical suspects.

### **Peanut Mosaic**

Martin (136) in 1941 recorded peanut mosaic from Kailua, Oahu where peanut rosette was also noted. No peanut mosaic has been reported in the literature as a distinct disease. However, Smith (215) pointed out that the first symptoms of rosette consist of a leaf mottle. Furthermore, some plants exhibit a pronounced mosaic pattern in the leaves and only a limited amount of stunting. In view of these circumstances it is possible that the mosaic of peanut recorded by Martin was caused by the peanut rosette virus complex. Nevertheless, it may also be that a mosaic-inducing virus exists which is distinct from the rosette virus. Diseases which are characterized by great diversity of symptoms in the same host plant frequently prove to be due to a complex of related or unrelated virus strains which may be transmitted in varying proportions at different times and under different conditions.

### **Pepper Mosaic**

Parris (146) in 1941 and Martin (136, 137, 138) in 1941, 1942 and 1943 reported mosaic on pepper in Hawaii. Although pepper mosaic in the Territory has received only occasional and brief notation in the literature, it is a very common disease. During the past two years the writer has seen several plantings on Oahu in which approximately 50 per cent of the plants were infected.

The viruses responsible for pepper mosaic in Hawaii and their insect vectors have not been determined. This disease is usually attributed to tobacco mosaic virus which, according to Holmes (96), causes "yellowish primary lesions followed by systemic chlorotic mottling." Cucumber mosaic virus, southern celery mosaic strain, also causes symptoms in pepper which are described by

Holmes (96) as "mild mottling and grayish discoloration of leaves, malformation of fruit, stunting of plant." Symptoms of both general types have been observed in Hawaii.

### Eggplant Mosaic

In 1942 Martin (137) reported "common mosaic" on eggplant at Ewa, Oahu. I have been informed by members of the Vegetable Crops Department of the University of Hawaii Agricultural Experiment Station that a mosaic on eggplant has been noted on Oahu on several occasions during recent years. The identity of this disease is not known. Eggplant (*Solanum melongena*) has been used in relatively few virus studies. Harter (85) in 1938 reported it susceptible to cucumber mosaic virus, lima-bean mosaic strain (*Marmor cucumeris* var. *phaseoli* of Holmes). This virus strain is transmitted by *Aphis gossypii* and *Myzus persicae*. Black (15) in 1938 listed eggplant as a susceptible host of potato yellow-dwarf virus, which is not known to occur in Hawaii. Holmes (96) lists eggplant as susceptible to tobacco mosaic virus, tomato spotted wilt virus and tobacco ringspot virus.

### Tomato Fern Leaf

The disease in tomatoes known as fern leaf is caused by the presence in tomatoes of the common cucumber mosaic virus. This disease is characterized by stunting of the plant and particularly by reduction or absence of the lamina of the leaves leaving filiform or "shoestring" leaflets.

Smith (215) stated that these symptoms may be produced also by tobacco mosaic virus (tomato mosaic virus) under conditions of low temperature and especially of low light intensity. However, Mogendorff (147) in 1930 reported the results of extensive experiments on the fern leaf problem which do not agree with those reported by Smith. Mogendorff (147) stated that "typical fern-leaf symptoms could not be produced with the ordinary tobacco-mosaic or tomato-mosaic virus (Tobacco virus 1) under any of the environmental conditions to which the infected host was submitted." He found further that fern leaf was produced only irregularly on tomato by cucumber mosaic virus (Cucumber virus 1) if the infection had been accomplished by mechanical means. However, fern leaf could be produced regularly and at will if young tomato plants were infected with cucumber mosaic virus by means of the green peach aphid, *Myzus persicae*. The production of fern leaf symptoms was also found to depend upon (a) the atmospheric temperature and (b) the age of the plants at the time they are infected. The optimum atmospheric temperature for the expression of symptoms was found to lie between 18° and 22° C., with an approximate minimum temperature of 15° C. and an approximate maximum of 25° C. Moreover the tomato plants had to be infected while they were still small if typical fern leaf symptoms were to develop.

Although several different species of aphids have been demonstrated to transmit cucumber mosaic, reports of experiments specifically designed to study fern leaf in tomatoes have not been encountered in which aphids other than *Myzus persicae* were used as the vectors. The fact that Mogendorff found fern leaf could be induced readily by aphid transmission of the virus but only irregularly when the tomato plants were artificially inoculated, is of interest.

Parris (177) reported this disease as being very common in Hawaii. Members of the Vegetable Crops Department of the University of Hawaii Agricultural Experiment Station have informed the writer that the occurrence of tomato fern leaf in Hawaii has been found to be sporadic. The greatest amount appears during the winter months as would be expected in view of Mogendorff's findings regarding temperature and light.

### **Tobacco and Tomato Mosaic**

*Synonyms:* Tobacco mosaic virus, tomato mosaic virus, pepper mosaic virus.

Mosaic has been known to occur in Hawaii since 1919 when it was recorded on tobacco (*Nicotiana tabacum*) by Carpenter (32).

This virus is of importance not only because of the economic losses which have resulted from the disease it causes, but also because it has figured so prominently in the research on the nature of viruses. The first published record of experimental transmission of a virus disease was by Iwanowski in 1892 who reported that sap of tobacco plants showing mosaic symptoms infected healthy plants after the sap had passed through a bacteria-proof filter.

Working with this same virus, Stanley (218) in 1935 succeeded in isolating and crystallizing the tobacco mosaic virus in what has been considered to be pure or nearly pure form.

There are several strains of tobacco mosaic virus which produce different symptoms in the tobacco plant. The strain which has received most investigation and which is of greatest economic importance is one which we speak of as common tobacco mosaic or tomato mosaic. This is an exceedingly infectious virus and can be transmitted to healthy plants in various ways such as by leaf contact, contaminated tools, clothing or other articles, and through the soil. It withstands drying in tobacco leaves for years without losing the ability to infect healthy plants.

Despite the highly infectious nature of tobacco mosaic virus, it has proved to be one of the most difficult of all viruses to transmit by means of insects. Cleveland (47) in 1931 listed *Thrips tabaci*, *Epitrix cucumeris* and *Tetranychus telarius* as probable (though unimportant) vectors of tomato mosaic virus. These conclusions were based on the abundance of the species in the field and on a limited number of vector tests. In view of present knowledge

concerning the transmission of this virus, it is highly improbable that these species actually are vectors. For many years it was assumed that aphids were largely responsible for the spread of tobacco mosaic in the field. However, Hoggan (91, 93) in 1931 and 1934 demonstrated that aphid transmission of this mosaic was infrequent when compared with many other aphid-transmitted mosaics. She worked with *Myzus pseudosolani*, *Myzus persicae*, *Myzus circumflexus* and *Macrosiphum solanifolii*. According to these experiments the aphids consistently failed to transmit the virus from tobacco to other hosts. However, transmission was obtained with some regularity from tomato to tobacco and other solanaceous hosts. Transmitting efficiency of three species was determined by transferring known numbers of aphids from diseased *Lycopersicon pimpinellifolium* (93) to hybrid plants of *Nicotiana tabacum* x *N. glutinosa* and counting the number of local lesions of tobacco mosaic produced on the hybrid host. This experiment demonstrated that, "with *Myzus pseudosolani*, about 1 aphid in 129 caused infection; with *Macrosiphum solanifolii* about 1 aphid in 140; and with *Myzus persicae* about 1 aphid in 800 or more." Comparative tests in the transmission of a crucifer virus and sugar beet mosaic virus indicated that approximately 1 aphid in 4 or 5 of *Myzus persicae* served as a vector.

Hoggan's experiments were very significant in that they demonstrated the importance of a particular host species being used as the source of the virus in studies of insect transmission.

Parris (177) in 1938 stated that mosaic is the most prevalent tomato virus disease in Hawaii. Of great concern to tomato growers in Hawaii and in other parts of the world is the role of insects in spreading the tobacco mosaic virus from tomato to tomato as tomato mosaic. While Hoggan's experiments demonstrated the ability of *Macrosiphum solanifolii* to transmit mosaic from tomato to tobacco and some other hosts, no experiments have been reported in the literature on the insect transmission of this disease from tomato to tomato. It is conceivable that if aphids can acquire the virus from tomato more readily than from other host plants, they may also be able to infect tomato with greater efficiency than other plants.

Hoggan (93) concluded that it "seems unlikely that any appreciable amount of dissemination of tobacco mosaic may be brought about by aphids, except perhaps from tomato."

In 1937, Chamberlain (45) reported that attempts to transmit mosaic from tobacco, tomato and black nightshade to tobacco by means of *Myzus persicae*, *M. solani* and *Macrosiphum solanifolii* were unsuccessful in New Zealand. Failure to duplicate Hoggan's results may have been due to differences in technique or possibly even to inherent differences in the transmitting ability of the aphid stocks used.

In 1934 Chamberlain (41) had reported that in New Zealand healthy tomato plants growing next to infected ones did not become infected with mosaic even though the plants had carried many *Macrosiphum solanifolii* and *Myzus solani* early in the season. Absence of rapid spread in a restricted local situation such as reported by Chamberlain does not warrant the conclusion that aphids do not play an important role in the spread of tomato mosaic. The evidence seems convincing that this virus is rarely transmitted by aphids from hosts other than tomato and in all probability spread of the disease by aphids from tomato to tomato is at a relatively low rate when compared with most aphid-transmitted viruses. Nevertheless, even an inefficient vector may be responsible for serious crop losses from virus diseases when the vector occurs in large numbers as does *Macrosiphum solanifolii* in many tomato fields in Hawaii during the cooler months of the year. Such a vector may do its greatest damage by establishing new and scattered foci of infection in a field or region. Even though the number of plants infected by the aphids may be relatively low, the disease may thereby become widely scattered and result in subsequent spread to surrounding plants by more efficient means of transmission such as leaf contact, or contamination of clothing, tools and machinery.

There is a definite need for determining the role of aphids in the spread of tomato mosaic in Hawaii.

### **Tomato Streak**

This virus disease of tomatoes was reported by Parris (177) to be present in Hawaii. He also described the disease symptoms. According to information received from the Vegetable Crops Department of the University of Hawaii Agricultural Experiment Station, this disease, though present, is not common in Hawaii. Smith (215) calls this virus *Lycopersicum virus 1* and states that it is similar to, but distinct from, tobacco mosaic virus. Parris (177), on the basis of a report by Jones and Burnett (108), described it as a combination of tomato mosaic virus and potato mottle or X virus in tomato. However, Holmes (96) treats it as a single strain of tobacco mosaic. It has not been shown to be transmissible by insects. However, if ordinary tomato mosaic (tobacco mosaic) is a component part, this portion could be transmitted by the aphid vectors reported for tobacco mosaic.

### **Tomato Mottle Mosaic**

This disease, characterized by faint interveinal mottling and some necrotic spots on the leaves, was reported by Parris (177) to occur in Hawaii but it is not common. It was reported (177) to be caused by the potato mottle virus (X virus) in tomato. No insect vector is known.

### Tomato Spot Necrosis

Parris (177) listed this disease as occurring in Hawaii. However, it is not considered common in the Territory. According to Jones and Burnett (108) it is caused by the presence in tomato of rugose mosaic virus of potato. Rugose mosaic is produced by a combination of potato mottle virus (potato latent or X virus) and the veinbanding virus described by Dykstra (55). A similar disease of tomatoes produced by potato mottle virus in combination with a strain of tobacco mosaic virus is described by Holmes (96). Tomato spot necrosis has not been demonstrated to be insect transmissible although one of its components, veinbanding, is readily transmitted by *Myzus persicae* and *Macrosiphum solanifolii* (113).

### Tomato Veinbanding Virus

This is the component of rugose mosaic of potato which is transmitted by *Myzus persicae* and *Macrosiphum solanifolii* (113). Parris (177) recorded its occurrence in Hawaii and stated that its detrimental effect on the plant is of minor importance.

### Tomato Aucuba Mosaic

Parris (177) reported aucuba (yellow) mosaic of tomato in Hawaii but it is not common. No insect vectors are known.

### Spotted Wilt

(Caused by spotted wilt virus, typical strain, *Lethum australiense* var. *typicum* Holmes)

*Synonyms:* Pineapple yellow spot virus, Ananas virus 1, Tomato virus 1, Lycopersicum virus 3, Kromnek disease virus of tobacco and tomato, "Vira-Cabeça" virus of tobacco and tomato, "Corcova" virus of tobacco and tomato.

Spotted wilt is an important virus disease in many parts of the world. Since its discovery in Australia (31) it has been reported from all of the main regions of the world except the Orient. Norris (157) in 1943 reported the presence in Australia of three strains of spotted wilt virus. These were designated as mild strain, ringspot strain and necrotic strain. The necrotic strain was purified and Norris stated that it appeared to be identical with the virus described from Oregon by Milbrath (146) in 1939, as tomato tip blight. Holmes (96) lists tip blight as a distinct strain of spotted wilt.

*Insect transmission.* Sakimura (200) in 1940 presented a review of the literature published up to 1939 on spotted wilt with particular reference to the insect vectors. Pittman (187) in 1927 reported transmission of spotted wilt virus in Australia by means of *Thrips tabaci*. Samuel *et al.* (201) and Bald *et al.* (8) in 1930 and 1931 demonstrated that the virus was transmitted in Australia by two species of thrips. One is a species of *Frankliniella*, listed in most



literature as *F. insularis* Franklin. The other is *Thrips tabaci*. The identity of the *Frankliniella* species has been the cause of much confusion. Samuel *et al.* (201) reported that the species used in their transmission test was identified by Dr. G. D. Morison as *Frankliniella insularis*. However, other material from the same source was sent to A. A. Girault in Queensland who described the thrips as a new species, *Parafrankliniella nigripes*, in 1928. Girault's description was ignored and, when the fact became apparent that the use of the name *insularis* was based upon a misidentification, Andrewartha (5) in 1937 described the species as new under the name *F. lycopersici*. This latter name was used by Sakimura (200), Leach (122) and others. However, since the species was validly described as *nigripes* by Girault in 1928, the name *lycopersici* And., applied in 1937, must be considered a synonym. The common spotted wilt vector of Australia is therefore *F. nigripes* (Girault) as listed by Essig (61) in 1942.

Samuel *et al.* (201) and Bald *et al.* (8), in addition to determining two vectors of spotted wilt virus, also reported on the unusual specific relationships which exist between the virus and the vectors. The virus must be acquired by the thrips while the latter are still in the larval stage. The virus is retained through pupation, and the emerging adults may serve as vectors. If the adult stage has been attained before the thrips are permitted to feed on virus inoculum, they are incapable of serving as vectors.

Linford (125) in 1932 reported transmission of yellow spot of pineapple in Hawaii by means of *T. tabaci*. At the time this work was done, the coidentity of yellow spot and spotted wilt was not known although Linford noted that the peculiar relationship of the virus to the vector (which he discovered independently) was the same as that existing between spotted wilt and its vectors. The virus has a relatively long incubation period in the vectors, varying from 5 to 10 days. In Hawaii this was found by Linford to be approximately 10 days in *T. tabaci*.

Bailey (6) in 1935 reported that *T. tabaci* in Hawaii was found by Dr. Carter to retain the virus for about 30 days during adult life.

Smith (211, 213) in 1931 and 1932 demonstrated that *T. tabaci* is the vector of spotted wilt in England. Gardner *et al.* (76, 77, 78) in 1934, 1935 and 1937 reported transmission of spotted wilt to a large number of plant species in California by means of *T. tabaci* and *Frankliniella moultoni* Hood. In 1936 Essig and Michelbacher (62) and in 1942 Essig (61) cited *F. occidentalis* Perg. as a vector in California. Sakimura (200) reported that he had been informed in private correspondence from Dr. S. F. Bailey, of the University of California, that the inclusion by Essig and Michelbacher of *F. occidentalis* Perg. in the place of *F. moultoni* Hood "is a matter of different view on the classification of the species."

Moore and Anderson (148, 149) in 1933 and 1939 discussed Krommek disease of tobacco and tomato in South Africa where transmission was obtained by means of *Frankliniella schultzei* and *T. tabaci*. These authors stated (149) that the virus is probably identical with spotted wilt of Australia, Europe and America. Carter (37) in 1939 reported his observations on the Krommek disease of South Africa. Here he found, in fields surrounded by Krommek-diseased weeds, symptoms on pineapple, indistinguishable from yellow spot of pineapple in Hawaii. *F. schultzei*, vector of Krommek disease, was also found in the flowers of pineapple.

Silberschmidt (207) in 1937 announced that Dr. Santos Costa had obtained transmission of "Vira-Cabeça" disease of tobacco in Brazil by means of *tabaci* and *Frankliniella* sp. Sakimura (200) quoted personal correspondence regarding the identity of the Brazil disease and its vector as follows: "Dr. A. S. Costa . . . recently informed the writer that the virus of 'Vira-Cabeça' of tobacco and tomato, widely distributed in Brazil, has been proven to be identical with S. W. (spotted wilt) virus; that the vector is a species of *Frankliniella*, possibly *F. paucispinosa* Moulton, which is also known to be the vector of 'Corcova' of tobacco and tomato in Argentina."

In 1938 and 1940 Fawcett (64, 65) reported transmission of "black pest" of tomatoes ("Corcova" disease of tobacco) in Argentina by means of *F. paucispinosa*, and stated the disease appeared to be identical with spotted wilt. The same author announced (65) that "Vira-Cabeça" of Brazil appeared to be identical with "Corcova" of Argentina.

*Host range of spotted wilt virus.* The host range of this virus is very large. Smith (215) listed over 100 susceptible species which occur in 23 different families. Most of them occur among the dicotyledons but some are monocotyledonous species. More host plants of the virus have been found in the Solanaceae than in any other family. In tomato, the disease is very destructive in several parts of the world.

In Hawaii, Kikuta *et al.* (112) in 1945 announced the development of a tomato variety, Pearl Harbor, which is resistant to Hawaiian spotted wilt. However, they suggest that preliminary tests with the Pearl Harbor variety in other parts of the world indicate it may not possess resistance to some strains of the spotted wilt virus.

In peas, spotted wilt virus causes streaking and necrosis of pods, stems and leaves. In 1931 Linford (124) transmitted pineapple yellow spot virus from *Emilia sonchifolia* to peas by means of *T. tabaci* and noted that the symptoms appeared to be identical with the pea streak he had observed at various localities across the United States. He suggested that the pea streak on the mainland was caused by the same or a related virus. At the time of this

report the coidentity of yellow spot and spotted wilt had not been established. In 1936 Whipple (239) transmitted spotted wilt to peas by *T. tabaci* and obtained typical pea streak symptoms.

### Yellow Spot of Pineapple

(Caused by spotted wilt virus in pineapple)

This disease, first reported publicly by Illingworth (97) in 1931, was discovered in Hawaii in 1926. Its sudden appearance, rapid spread in some areas during the first few years, and the destructive effect produced on the pineapple plant appeared to mark this disease as a major pineapple problem. The steps leading to the determination of the insect vector of the disease in Hawaii constitute an interesting record since it provides an instance in which the probable identity of the vector group was established before the vector had actually been observed as a pineapple inhabiting insect. The procedure has been discussed by Illingworth (97) and Linford (125). Illingworth carried out preliminary exploratory experiments in search of the vector. The investigations which established the identity of the vector were conducted by Linford. Undetermined *Nysius*, aphids, leafhoppers, thrips, chironomid maggots, nitidulid beetles, spring tails, red spiders, tarsonemid mites as well as the pineapple mealy bug, bud-moth caterpillars and *Scolia manilae* Ashm. wasps were tested without success by Illingworth (97). Dr. R. N. Chapman (97, 125) then discovered microscopic insect punctures associated with the yellow spot symptom on the pineapple leaves. These were first assumed to be the feeding punctures of a relatively large sucking insect. However, Linford (125) discovered that the punctures represented the oviposition site of a small insect as evidenced by the finding of egg membranes in the reniform cavities beneath the surface openings. The only insects which seemed to fit the specifications for such a puncture were thrips. This was demonstrated subsequently by the findings of unhatched eggs, from which thrips emerged, in pineapple leaves taken from a disease-infected area. As these investigations were proceeding, another host plant of the virus was also being sought. The presence of a similar disease on *Emilia sonchifolia* in infected areas resulted in the investigation of this plant, its virus disease and the thrips, *Thrips tabaci*, which infested it. Proof of the vector's identity was established soon thereafter. When thrips were transferred from diseased *Emilia* to healthy pineapple, typical yellow spot disease was transmitted.

In addition to *sonchifolia*, *Emilia* species designated as *Emilia* No. 3 and *Emilia* No. 4 have been reported by Sakimura (198) to serve as host plants for the virus and for the thrips vector in Hawaii. Other host plants of *Thrips tabaci* in Hawaii and its life history on *Emilia sonchifolia* have been reported by Sakimura (197).

Sakimura (199) in 1940 demonstrated in a long series of tests that *Thrips nigropilosus* Uzel is not able to transmit spotted wilt virus (yellow spot virus) in Hawaii. Preliminary transmission tests with *Hercinothrips femoralis* (Reuter) were also negative (199).

The fact that the yellow spot disease did not become a limiting factor to pineapple production as had been feared, but has remained a minor problem except for occasional outbreaks, is due to the host plant preference shown by the vector as discussed by Carter (35, 38). Pineapple normally is not a host of *Thrips tabaci* which, in Hawaii, breeds preferentially on *Emilia*. Furthermore, Carter (38) reported that "Incidence of yellow spot disease in pineapple is not correlated with *Thrips tabaci* populations on *Emilia* in nearby areas. This is accounted for on the grounds that *Emilia* is a favored host from which dispersal does not normally occur." Factors which may be responsible for the occasional sporadic movement of thrips from infective *Emilia* to pineapple plants are destruction of the *Emilia* by means of cultivation or drought (38).

Although the possibility was considered for some time that tomato spotted wilt virus and pineapple yellow spot virus were the same, their coidentity was not well established until 1940 when Sakimura (200) and Parris (181) published results of their investigations in Hawaii. By means of *Thrips tabaci*, Sakimura transmitted yellow spot virus to and from spinach, broad bean, celery, potato, eggplant, bell pepper, tomato, tobacco, *Nicotiana glutinosa* L., *Datura stramonium* L., petunia, chicory, endive and lettuce, all of which are known to be susceptible to the spotted wilt virus. The symptoms produced were identical with those recorded for spotted wilt. Plants known to be immune from spotted wilt virus were also found to be immune to yellow spot virus.

Parris (181) transmitted the tomato spotted wilt virus mechanically from tomato to tomato and potato and from *Emilia sonchifolia* to *Emilia* and tomato. On the basis of host range and symptoms, he concluded that tomato spotted wilt and pineapple yellow spot were probably caused by the same virus.

The joint study of this problem by Sakimura and Parris was undertaken after an outbreak of a tomato disease, which appeared to be identical with spotted wilt (176), occurred in Hawaii in 1937. This situation provided the opportunity and need for determining the relationship of pineapple yellow spot and tomato spotted wilt.

### Tomato Tip Blight

*Synonyms:* Tomato spotted wilt virus, tip blight strain (*Lethum australiense* var. *lethale* Holmes).

Martin (138) in 1943 reported the presence in Hawaii of a tomato disease which he considered distinct from spotted wilt and believed would prove to be tomato tip blight as reported by Milbrath (146) in 1939 in Oregon. The properties of the virus were

studied by Milbrath (146), who considered the disease to be new. Transmission was obtained by means of *Thrips tabaci* (146).

The writer is following Holmes (96) and Norris (157) in classifying this as a strain of spotted wilt virus. Norris studied three strains of tomato spotted wilt virus in Australia, one of these, designated as necrotic strain, was discussed by Norris in part as follows: "This strain appears to be identical with the virus described by Milbrath in Oregon as tomato tip blight. The symptoms produced on tomato, tobacco, and other hosts correspond closely. In Oregon this necrotic strain was apparently separated out by chance from the others, but its occurrence in close association with ordinary spotted wilt was observed. Milbrath also noted that occasionally both viruses occurred together in tomato. In such cases it would appear that other strains were present but that the necrotic strain occurred in very high concentration."

The fact that tomato tip blight is transmitted by *Thrips tabaci*, suggests strongly that the affinity of this virus and that of spotted wilt is exceedingly close, because this thrips species has not yet been incriminated as a vector of any virus proven to be outside of the spotted wilt complex.

### Potato Virus Diseases in Hawaii

Virus diseases, if prevalent in potato plantings, seriously reduce the crop yields in quantity. Parris (176, 177) reported figures on yield reduction in Hawaii due to the use of virus diseased seed stock. Dr. W. A. Frazier, of the University of Hawaii has informed the writer<sup>11</sup> that in Hawaii potato losses due to virus diseases are not ordinarily very serious in areas where mainland-grown certified seed is used. However, the practice of some farmers of using seed grown locally often results in very serious losses due to potato viruses. This is due to the fact that potato viruses are transmitted through the tubers. If disease-free seed is used in Hawaii, most of the plants escape virus infection until late in the season when it is too late for the virus to injure the crop materially. However, before they are harvested, many normal-appearing tubers may contract virus infection. When such tubers are used as seed for subsequent crops a number of diseased plants are produced early in the season. These provide sources of infection from which insect vectors may transmit the viruses to surrounding healthy plants. Seed stock should therefore be obtained from areas which are relatively free from potato virus diseases.

Although no transmission experiments involving potato viruses have been reported in Hawaii, Parris (177) listed the following diseases as occurring in the Territory: mottle, mild mosaic, crinkle mosaic, leaf rolling mosaic, veinbanding, rugose mosaic, and leaf roll.

<sup>11</sup> Personal communication.

## Potato Mottle Virus

*Synonyms:* Latent virus; "healthy potato virus"; Virus X.

Dykstra (55) in 1939 reviewed the literature on this—the most ubiquitous of all potato viruses known. It has been shown to be present in masked form in all the tubers of most, and perhaps all, of the commonly used varieties of "apparently healthy" potatoes. In Europe this virus has been found to produce a mild form of mottling in some varieties.

Dykstra (55) transmitted this virus to *Amaranthus retroflexus* and stated, "This is believed to be the only potato virus that has been successfully transmitted to plants outside the Solanaceae." Alone or in combination with other viruses it causes diseases of potato, tomato, pepper and other plants.

Holmes (96) classifies this virus into three strains, (a) potato ringspot strain, which is masked in potato but produces systemic necrosis and ring shaped lesions on tobacco and pepper; (b) yellow-mottle strain, which imparts a yellow cast to potato foliage and in tomato causes yellow-mottling mosaic and occasional necrosis of the young leaves (see tomato mottle mosaic); (c) masked-mottle strain, which produces symptomless systemic infection in potato, tobacco and *Datura stramonium*, but which produces systemic necroses in pepper.

No insect vector has been found capable of transmitting any of the strains of potato mottle virus.

## Potato Mild Mosaic

According to Dykstra (55) the mild mosaic virus, in the absence of the mottle or X virus, causes only a very faint mottling in the potato foliage. However, in combination with virus X (which alone shows no symptoms in many potato varieties) mild mosaic produces a pronounced mottling and crinkling of the foliage. According to Parris (177) plants produced from tubers infected with mild mosaic may die prematurely.

Holmes (96) listed *Aphis rhamni* B. de Fonsc. (= *A. abbreviata* Patch) and *Myzus persicae* as the vectors of potato mild mosaic. However, Dykstra and Whitaker (57) in 1938 reported experiments which demonstrated that this virus can be transmitted by *Myzus persicae*, *M. circumflexus*, *M. solani*, and *Macrosiphum solanifolii*.

Reports from the Vegetable Crops Department of the University of Hawaii Agricultural Experiment Station indicate that this virus is common in some potato plantings in Hawaii.

## Potato Crinkle Mosaic

This disease is similar to mild mosaic but differs in that the leaflets are more ruffled and the mottle areas are larger. Like mild mosaic and rugose mosaic it is a composite disease composed of

the mottle or X virus and at least one other component. When X virus is removed, the remaining component causes only a faint mottling. When X virus is added, the mottling becomes pronounced and the leaves become crinkled (55).

Dykstra and Whitaker (57) reported transmission of crinkle mosaic free from X virus by means of the same aphids which transmitted mild mosaic, i.e. *Myzus persicae*, *Myzus solani*, *M. circumflexus* and *Macrosiphum solanifolii*. As in the case of mild mosaic and rugose mosaic, the aphids transmitted not the disease as named, but only one component since X virus, the other necessary component, is not transmitted by insects. The percentage of positive transmission varied from 0 to 100 per cent in different experiments.

### Potato Leaf Rolling Mosaic

This disease discussed by Smith (215) under the name Solanum virus 11, is characterized by a diffused mottling and an upward rolling of the leaves which are flaccid and resemble the rolling of leaves on plants affected with *Rhizoctonia* or blackleg (55, 215). It differs from leaf roll in that the plants are not dwarfed and the leaves are not tough. Schultz and Folsom (203), who originally described the disease, reported transmission by means of unspecified aphids. No report of insect transmission has been published by other workers.

### Potato Veinbanding Virus

Holmes (96) classifies this virus as cucumber mosaic virus, veinbanding strain.

Smith (215) lists veinbanding virus, potato virus Y and stipple streak virus as synonyms of Solanum virus 2. Dykstra (55), however, treats veinbanding, Y and stipple streak viruses as related but distinct strains.

Veinbanding is transmitted by *Myzus persicae*, *M. solani*, *M. circumflexus*, and *Macrosiphum solanifolii* (57, 113). This virus is characterized by crinkling and downward curling of the leaves. The veins of older leaves become necrotic. Diseased plants are stunted and usually die prematurely (55). This virus in combination with the potato mottle or X virus produces rugose mosaic of potato (55).

### Potato Rugose Mosaic

This disease is the result of the presence in potato of mottle or X virus and the veinbanding virus. Since the X virus component of rugose mosaic is not transmitted by insects, the records of insect transmission of rugose mosaic actually refer to transmission of the veinbanding component (see "Veinbanding Virus"). However, the almost universal occurrence of mottle or X virus in potato means that whenever veinbanding virus is transmitted to a potato plant, the resultant disease will probably be rugose mosaic.

According to Smith (215), the characteristics of this disease are: mottling of the upper leaves and dark, necrotic veins on the lower leaves, and crinkled and rugose foliage. Severely affected plants are stunted and the tubers are small. The mottle symptoms may be masked by high temperatures, but the rugosity and stunting persist.

This disease is sometimes serious in Hawaii.

### Potato Leaf Roll

Potato leaf roll is considered by Smith (215) to be the principal cause of potato degeneration in several parts of Europe and the British Isles. It is also common in some parts of North America. In Hawaii, leaf roll has not been a serious problem.

The symptoms of leaf roll make it relatively easy to identify. The leaves of diseased plants are rolled, thick, rigid and leathery. This is reportedly due to an abnormally high starch content which, in turn, results from prevention of normal food translocation in the plant because of phloem necrosis in the stems. Affected plants are dwarfed and tubers are reduced in size and number. This virus has not been found to be transmissible by mechanical means.

*Insect transmission.* Many workers have reported insect transmission of leaf roll and the accounts are sometimes conflicting. Vectors have been reported as follows: *Aphis rumicis* L. and *Myzus persicae* by Ortwiijn Botjes (165) in 1920; *Calcoris bipunctatus*, a plant bug, and *Typhlocyba ulmi* (Linn.), a leafhopper, by Murphy (151) in 1923; *Macrosiphum solanifolii* and *Myzus pseudosolani* by Murphy and McKay (152) in 1929; *Myzus persicae*, *M. pseudosolani*, *Aphis rhamni*, *Eupteryx auratus*, *Lygus* sp., *Psyllioidis affinis*, and the larvae of *Tipula paludosa* by Elze (59) in 1927, the last species being listed as an underground vector; *Macrosiphum solanifolii*, *Myzus persicae* and *Empoasca fabae* by Cleveland (47) in 1931 with the latter two species listed as the main vectors in Indiana. Smith (210, 212, 215) in 1929, 1931 and 1934 failed to transmit the virus by means of *Calcoris bipunctatus*, *Lygus pabulinus*, *Eupteryx auratus*, *Chlorita viridula*, *Psyllioidis affinis*, and *Macrosiphum gei*, (= *solanifolii*) but obtained transmission with *Myzus persicae*, *M. pseudosolani* and *M. circumflexus*.

This disease is of singular interest because of the unusual relationship known to exist between the virus and *Myzus persicae*, one of its vectors (215). After this aphid has fed on leaf roll inoculum, an incubation period of from 48 to 54 hours is required before *Myzus persicae* can infect a healthy plant. Furthermore, this species retains the virus in an infective condition for long periods of time while feeding on plants which are immune to the virus. A similar relationship has been reported by Osborn (168, 170) to exist between pea enation mosaic virus and its two vectors, *Macrosiphum*



*pisi* and *M. solanifolii*, and by *Ocfemia* and Buhay (160) for *Pentalonia nigronervosa* in transmitting abacá bunchy top virus in the Philippines. Except for a few cases such as these, other aphid-transmitted viruses are reported to require no incubation period in the aphid vectors. Also, such viruses are not retained by their vectors for more than a few hours at most after the last feeding on virus inoculum.

Dykstra and Whitaker (57) reported that transmission experiments using *Myzus persicae*, *M. circumflexus*, *M. pseudosolani* and *Macrosiphum solanifolii* resulted in a high percentage of potato leaf roll virus transmission by means of the *Myzus* species. *Macrosiphum solanifolii* proved to be a relatively inefficient vector in most experiments, although occasionally a high percentage of transmission was accomplished with this species. A possible explanation was suggested for the difference in transmitting ability demonstrated by the aphids. This explanation was based on the tissues in which the aphids habitually fed. The three species of *Myzus* were found to feed in the phloem in practically all cases. They exhibited approximately equally high efficiency as vectors of the disease. *Macrosiphum solanifolii* fed in the vascular tissues in only 46 per cent of the cases observed. This suggests that phloem feeding may be necessary for the aphids to acquire and/or transmit the virus.

This explanation is a logical one in view of what is now known regarding the relation of viruses to plant tissues. Bennett (12) has contributed greatly to our understanding of this problem. He has demonstrated that leaf-curl of raspberry and curly top of sugar beet are caused by viruses apparently closely limited to the phloem. He also pointed out that several other diseases, including potato leaf roll, which exhibit symptoms resulting from phloem disturbances, are not transmissible mechanically and ordinarily show the type of vector-virus relationship described for *M. persicae* and leaf roll virus.

The reported ability of many of the species listed as vectors of leaf roll needs further confirmation. In view of the incubation period of the virus and its long retention in *Myzus persicae*, and the fact that the disease is not mechanically transmissible, it seems somewhat doubtful that this virus could be transmitted by so many unrelated insect species, some of which would have to transmit the virus in a purely mechanical fashion.

### Bamboo Mosaic

Kunkel (114) in 1921 reported that what appeared to be mosaic had been observed several times on *Bambusa vulgaris* Wendl. in Hawaii. No further reference has been made in the literature to the disease.

### **Canna Mosaic**

Kunkel (114) in 1921 stated that mosaic had frequently been observed on *Canna indica* L. in Hawaii. No investigations of the virus or its manner of spread have been conducted.

### **Dianella odorata Bl. Mosaic**

Kunkel (114) in 1921 reported that in Hawaii "A disease closely resembling the yellow stripe disease of sugar cane occurs on *Dianella odorata* Bl." This plant belongs in the lily family.

### **Hippeastrum Mosaic**

In 1922 and 1924 (116, 117) Kunkel reported the common occurrence in Hawaii of a mosaic disease of *Hippeastrum equestre* Herb. This plant (commonly known as Barbados lily) is grown as an ornamental in Hawaii, but has also escaped from cultivation and grows wild in some of the valleys above Honolulu. Kunkel's investigation of the virus was primarily concerned with the study of amoeboid bodies in the cells of virus-diseased plants, but he was also interested in the manner in which the disease was disseminated in nature. Potted plants kept in insect-proof cages remained healthy, while most of those kept outside, a short distance from diseased plants, became infected with mosaic. These results suggested insect transmission. Kunkel made several attempts to transmit the virus by means of the corn aphid, *Aphis maidis*, but all tests were negative.

Smith (215) reported *Hippeastrum* sp. as a host of tomato spotted wilt virus in England, but the symptoms produced by this virus are distinct from those described by Kunkel for *Hippeastrum* mosaic in Hawaii.

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## A New Species of *Lepidosaphes* Attacking *Dendrobium* Orchids in Hawaii and California

(Homoptera: Coccoidea: Diaspididae)

By HOWARD L. MCKENZIE

State Department of Agriculture  
Sacramento, California

(Presented at the meeting of August 13, 1945)

During 1944 the California State Department of Agriculture, Bureau of Entomology and Plant Quarantine received for determination a species of scale insect heavily infesting pseudobulbs of *Dendrobium dearei* orchids at Honolulu, Hawaii. The orchid plants were presumably treated before entry into California, because no living scale insects were observed on the submitted plant portions. The material was submitted by D. T. Fullaway, Territorial Entomologist, who in correspondence, indicated the insect had been observed for several years doing considerable damage to orchid plants. Mr. Fullaway was under the impression that the species concerned might be the same as one recently described by the author as *Lepidosaphes mackieana*. An examination of the submitted specimens indicates the species is not *mackieana*, but instead, represents, as here interpreted, still another new species of this group. Specimens submitted early in 1944 by M. R. Bell, Inspector State Nursery Service, from *Dendrobium dearei* in a nursery at San Leandro, Alameda County, California were found to be identical with this species.

Since this scale insect has been causing damage to *Dendrobium* orchids in Hawaii, Mr. Fullaway has kindly suggested its description be included in the Proceedings of the Hawaiian Entomological Society. A description of the insect follows:

### *Lepidosaphes noxia* McKenzie, new species (figure 1)

**HISTORICAL BACKGROUND.** This species of *Lepidosaphes* was first collected at San Leandro, Alameda County, California in a commercial orchid nursery, on *Dendrobium dearei*, February 9, 1944 by M. R. Bell, State Nursery Inspector. Additional insect material was requested of Mr. Bell, and on March 8, 1944 a second collection was made by him from the same plants in the same nursery. Still another collection was made from the same host and locality on June 26, 1944 by J. B. Steinweden of this Department, and observations on extent and intensity of infestation were made by him. He has indicated that approximately 12 plants were found lightly infested with the scale, and that it was apparently being held in control in the nursery at San Leandro.

Prepared slide mounts of this species collected at Honolulu, Hawaii on *Dendrobium dearei* during April 1944 by William Kirch were submitted to this office for determination during May 1944 by D. T. Fullaway, Territorial Entomologist. Upon request, subsequent treated fresh material collected at Honolulu, July 19, 1944 by William Kirch, on pseudobulbs of the same host, was sent to the author by Mr. Fullaway. Mr. Fullaway indicated by correspond-

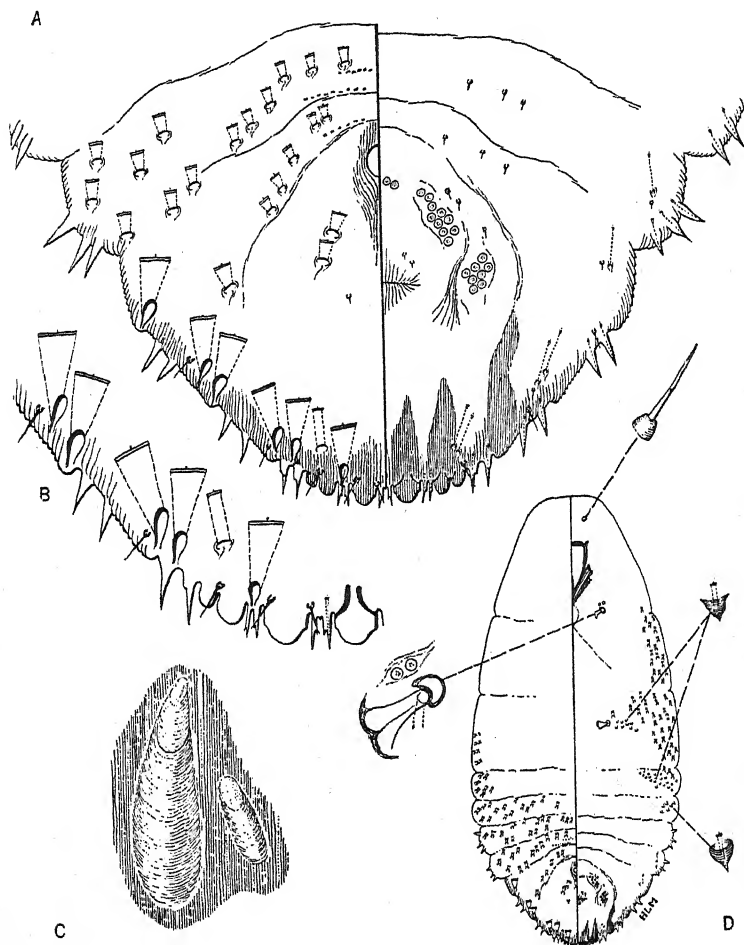


Figure 1.—*Lepidosaphes noxia* McKenzie, new species. A, pygidium of the adult female; B, details of the dorsal aspect of the pygidial margin; C, habit; D, body of adult female. Unlettered details are connected to their points of origin by guide lines and should be readily identifiable.

ence, that the scale has been noticed for several years doing considerable damage to orchid plants of the *Dendrobium* group. The infested pseudobulb material sent to the present author by Mr. Fullaway showed marked damage to the orchid tissue particularly where the leaves are attached to the leads. This visible injury causes death to the leaves.

**HOSTS AND DISTRIBUTION.** Type and paratypes from orchid, *Dendrobium dearei*, in a commercial orchid nursery, San Leandro, Alameda County, California, collected February 9 and March 8, 1944 by M. R. Bell, State Nursery Inspector. Additional paratypes on pseudobulbs of the same host are available from Honolulu, Hawaii, collected July 19, 1944 by William Kirch.

**HABIT.** Scale insects occurring on the leads of orchids concentrating particularly where the leaf partially surrounds the lead. Scale of the female averages about 2.2 mm. long, pale brown, exuvium terminal; male smaller, much lighter in color than female, exuvium terminal.

**RECOGNITION CHARACTERS.** Length as mounted on microscope slide averages approximately 1.25 mm.; derm membranous at full maturity; abdominal segments but little produced laterally; antenna one-spined; perivulvar pores present in five groups, anterior groups ranging from 3-7, average 4, median ranging from 7-14, average 10, posterior group ranging from 4-9, average 7; median pygidial lobes relatively small, low and rounded apically, slightly once-notched on each side, second lobes bilobed, quite large and prominent in comparison with median pair; dorsal macroducts much smaller than marginal ones of pygidium, occurring across prepygidial abdominal segments 2-4 inclusive, and marginally only on first abdominal segment and metathorax, submedian macroduct group on sixth segment containing usually two ducts, on each side, a smaller, dorsal macroduct present slightly anterior to second pygidial lobes; ventral microducts and gland tubercles situated as indicated in accompanying figure.

**NOTES.** *Lepidosaphes noxia* will run to *L. newsteadi* (Sulc) in Ferris' key to species of this group, included in his Atlas of Scale Insects of North America published in 1942. It is structurally quite similar to that species except for its possession of a small dorsal macroduct located slightly anterior to the second pygidial lobes, and more numerous median groups of perivulvar pores. It is also closely related to *L. mackieana* McKenzie, but differs in the character of the median lobes which are only slightly once-notched on each side, whereas in *mackieana* they are laterally serrate, and also in the possession of only one-spined antenna as compared to two-spined in *mackieana*.

The type specimen of *Lepidosaphes noxia* will be deposited in the State Department of Agriculture collection at Sacramento, California, and paratypes in the Federal Bureau of Entomology and Plant Quarantine collection at Washington, D.C.

The accompanying figures were prepared by the author from type material.



## A New *Apanteles* from Hawaii (Hymenoptera: Braconidae)

By C. F. W. MUESEBECK

Bureau of Entomology and Plant Quarantine, Agricultural Research  
Administration, U. S. Department of Agriculture

(Presented at the meeting of August 13, 1945)

By virtue of its conspicuously fasciate wings and banded female antennae this is one of the most striking species of *Apanteles* known to me.

### *Apanteles trifasciatus*, new species

*Female*.—Length 3 mm. Head very nearly as wide as thorax; face shining, evenly covered with shallow, separated punctures, and with a median longitudinal keel above middle; malar space shorter than clypeus; vertex and temple closely punctate and dull. Thorax stout; mesoscutum with well separated, sharp punctures over most of its surface, subopaque except for a median area on posterior third and a smaller area at each of posterior lateral angles which are impunctate and polished; disc of scutellum evenly convex, impunctate, polished; scutellar furrow with about 10 foveae; polished area on lateral face of scutellum transverse, twice as broad as long, the large area in front of it mostly smooth; propodeum rugulose medially and apically, smooth and shining each side of middle on basal half, areola indicated but its margins low and irregular; mesopleuron impunctate and polished above the longitudinal impression, which is more or less aciculate and has a few indistinct shallow foveae; metapleuron impunctate, polished; posterior coxa impunctate, polished, strikingly compressed and almost keeled above; inner calcarium of hind tibia twice as long as outer but barely half as long as metatarsus; metacarpus a little longer than stigma; first abscissa of radius slightly longer than intercubitus, which it joins in a sharp angle; stub of second abscissa of radius as long as petiole of first discoidal cell; cubitus beyond intercubitus unusually long, longer than first abscissa of radius; nervellus straight, nearly perpendicular to mediella. Abdomen rather slender, widest at third tergite; plate of first tergite about as broad at apex as at base, broadest at the middle with the margins slightly bowed, longitudinally rugulose except on basal middle and at extreme apex, where it is smooth and polished; plate of second tergite transverse, much broader at base and more than twice as broad at apex as long, entirely smooth and polished; following tergites smooth and shining; ovipositor sheath about as long as abdomen, slightly shorter than the unusually long posterior tarsus, very slender but broadening slightly toward apex.

Black; face a little reddish medially below antennae; maxillary palpi dark basally, the apical three segments lighter; scape yellow; pedicel and basal six flagellar segments brown, these followed by four or five yellow segments beyond which antenna is dark brown or blackish; anterior leg yellowish, coxa brown; middle leg light brown, base of tibia white, tarsus yellowish; hind leg brownish black, trochanter brownish yellow, tibia, except for a broad white basal annulus, and metatarsus black, second and following segments of tarsus yellow; wings hyaline, anterior wing with a broad, dark fuscous band basad of a line extending from petiole of first discoidal cell, another slightly narrower band extending from stigma to posterior margin, and apex of wing broadly but not so deeply infumated; hind wing entirely hyaline; abdomen black; second tergite and base of third red; ovipositor sheath brown.



*Male*.—Like the female except for the uniformly dark brown antennal flagellum, the absence of the first transverse band of anterior wing, and the much shorter abdomen.

*Type*.—U. S. National Museum No. 57277.

*Type locality*.—Honolulu, Hawaii.

Described from 8 females and 2 males reared by August Busck, August 1915, from cotton bolls; 1 male labeled "Kaumama, Hilo, Hawaii, Aug. 22, 1927, M. Maneki Coll."; and 3 females and 6 males labeled "S. E. Koolau Mts., Palolo, Oahu, May 18, 1914, J. C. Bridwell Coll." The national collection has, in addition, 1 female labeled as having been collected by R. G. Oakley on an airplane arriving at Guam, August 11, 1938, from Hawaii.

# The Synonymy and Distribution of *Trichocorixa reticulata* (Guérin-Ménéville)

## Hemiptera: Corixidae

By R. I. SAILER

Bureau of Entomology and Plant Quarantine, Agricultural Research  
Administration, U. S. Department of Agriculture

(Presented at the meeting of October 8, 1945)

It seems advisable to publish certain information concerning *Trichocorixa reticulata* (Guérin-Ménéville) in order that this name may be available for use in the manual of Hawaiian insects now being prepared by E. C. Zimmerman. This species is the only known representative of the family Corixidae in the Hawaiian Islands, where it has been reported by F. X. Williams (26,\* p. 195) as numerous in lowland streams and pools and "fairly swarming in salty pools separated from the ocean by a low sandbar and having a salinity . . . greater . . . than the sea itself." As is indicated by this note, as well as by many additional records, *T. reticulata* is among the few aquatic insects sufficiently adaptable to live successfully in both fresh and saline water. As might then be expected, it is an extremely successful species both in numbers and distribution. The inadequate state of the taxonomy of the Corixidae, as well as failure to comprehend possible distributional limits of so versatile a form, resulted in this species having been named four times from as many widely separated localities. In 1857 specimens from Cuba were named *Corisa reticulata* by Guérin-Ménéville. In 1859 specimens from California were named *Corixa wallengreni* by Stål. In 1877 Buchanan F. White named the Hawaiian representatives of this species *Corixa blackburni*, and in 1901 it was named *Corixa mariae* by Champion, this time from the Tres Marias Islands. In 1929 (12, p. 24) Lundblad correctly placed *blackburni* White, 1877, as a synonym of *wallengreni* Stål, 1859. In 1931 (16, p. 214) and again in 1939 (25, p. 284) Jaczewski suggested that *mariae* Champion, 1901, was also a synonym of *wallengreni*. As a result of studies of type specimens made by H. B. Hungerford in 1927 at the British Museum of Natural History and the Paris Museum of Natural History, the notes of which he generously made available for my use, I am able to place both *mariae* and *wallengreni* definitely by synonyms of *Trichocorixa reticulata* (Guérin-Ménéville, 1857). Because of confusion concerning the type specimen of *reticulata*, notes on the type series, written by Hungerford during his visit to the Paris Museum, are quoted here in their entirety.

\* Figures in parentheses refer to the bibliography at the end of this paper.

"*Corixa reticulata* Guérin. 5 specimens: Museum Paris, Cuba, Coll. Guérin-Ménéville, ex-coll. A. Salle 1857.

"Here I believe are two species! Three specimens bear old written labels.—Two: a male and female are labeled '*Corixa reticulata* Guérin (type) Cuba male (or female).' In the same handwriting on the same sort of paper the third specimen is labeled '*Corixa reticulata* Signoret Manuscript. Male Cuba.' This third specimen is not the same species as the first male. It has a narrower interocular space and differently shaped strigil.

"I am placing a red label on the male marked *type* and designating it 'the holotype.' A specimen I have from Porto Rico, while a little darker in color pattern, seems to be identical and I am placing a compared with a type label on it.

"I think now that *C. (orixa) pygmaea* is also this species and that *wallengreni* and *blackburni* are also. They all have female pala shaped like the male somewhat."

Had this latter statement been entirely true, the name *reticulata* Guérin-Ménéville, 1857, would have fallen in favor of *pygmaea* Fieber, 1851; however, Lundblad, 1929,<sup>1</sup> published a redescription of Fieber's type in which he shows that *pygmaea* Fieber is a synonym of *verticalis* Fieber, the latter having page priority.

The problem was further complicated by Jaczewski (24, p. 338), who studied a specimen he obtained from the Paris Museum to which he refers as "co-type of *Corixa reticulata* Guérin, male from Cuba." This specimen he found to be identical with *Trichocorixa verticalis* (Fieber). If Jaczewski had designated the specimen that he studied the lectotype, it would then have been necessary to use *wallengreni* Stål, 1859, as the next available name. However, in view of Hungerford's notes, it is evident that Jaczewski did not study the specimen designated by Hungerford, in manuscript, as "holotype," but one which he mentions as "not the same species as the first male." Guérin-Ménéville's general description of *reticulata*, as well as the remark, "... mais elle en diffère par la forme réticulée des taches de ses élytres, surtout au delà du milieu, en arrière," in which he compares *reticulata* with *Corixa pygmaea* Fieber (now a synonym of *T. verticalis* [Fieber]), makes it clear that he was able to distinguish between these two forms. This evidence, supported by Hungerford's note concerning the identity of the specimen which bears the label "*Corixa reticulata* Guérin (type) Cuba male (or female)," makes it inadvisable to follow Jaczewski in placing *reticulata* as a synonym of *verticalis*. Had the entire type series been available to Jaczewski for study, it is probable that he would have arrived at a similar conclusion. It, therefore, seems proper to designate the specimen on which Hungerford placed the red label marked "type" as a lectotype. This definitely

<sup>1</sup> Arch. f. Hydrobiol. u. Planktonkunde 20: 312-317.

fixes *reticulata* Guér. as the name for that species of *Trichocorixa* having the nodal suture dividing the pruinose area of the embolar groove into apical and basal portions, the width of the synthlipsis exceeding the width of an eye along the hind margin as seen from above, and the length of the pala usually less than two-thirds the width of an eye along the ventral margin.

*T. reticulata* is primarily coastal and insular in distribution, ranging along the east coast of the Americas from New Orleans, La., to Dutch Guiana and including the West Indies, and on the west coast from San Francisco, Calif., to Lima, Peru. In the Pacific it is known from the Galápagos Islands and from the Hawaiian Islands. Lundblad has also recorded the species from Shanghai, China (12, p. 26).

The following list of references pertains to *Trichocorixa reticulata* (Guérin-Ménéville):

- (1) *Corisa reticulata* Guérin-Ménéville, 1857, in Sagra's Hist. de Cuba, 6: 423. (Cuba.)
- (2) *Corixa wallengreni* Stål, 1859, Kongl. Svenska Fregattens Eugenies Resa. Zool. 4: 268. Stockholm. (San Francisco, Calif.). **New synonymy.**
- (3) *Corixa blackburni* White, 1877, Ann. and Mag. Nat. Hist. 4[20]: 114. (Hawaiian Islands.)
- (4) *Corixa blackburni* White, 1878, Ann. and Mag. Nat. Hist. 5[1]: 366.
- (5) *Corisa reticulata*, Uhler, 1894, [London] Zool. Soc. Proc.: 224.
- (6) *Corixa mariae* Champion, 1901, Biologia Centrali-Americana, Rhynchota-Heteroptera, 2: 378. (Tres Marias Islands). **New synonymy.**<sup>2</sup>
- (7) *Arctocorisa blackburni*, Kirkaldy, 1910, Fauna Hawaiiensis, 2[6]: 554.
- (8) *Arctocorisa blackburni*, Perkins, 1913, Fauna Hawaiiensis, 1[6]: ccciii.
- (9) *Corixa reticulata*, Blatchley, 1926, Heterop. Eastern North America: 1084. (A synonym of *T. louisianae* Jacz.)
- (10) *Trichocorixa mariae*, Jaczewski, 1927, Ann. Mus. Zool. Polon., Warszawa 6[3]: 257.
- (11) *Trichocorixa blackburni*, Hungerford, 1928, Brooklyn Ent. Soc. Bul. 23: 174.
- (12) *Trichocorixa wallengreni*, Lundblad, 1929, Ent. Tidskr. 50[1]: 24-26, fig. 5, a-b; pl. IV, fig. 5. (Type material studied places *blackburni* as a synonym).

<sup>2</sup> The type of *Corixa mariae* Champion (6, p. 378) was studied by Hungerford at the British Museum in 1927, and in his notes he stated that it was "identical to the *reticulata* form." His sketch of the head and genital claspers confirms this view. Jaczewski, 1939 (24, p. 183), arrived at a similar conclusion, and placed *mariae* as a probable synonym of *wallengreni* Stål.

- (13) *Trichocorixa reticulata*, Lundblad, 1929, Arch. f. Hydrobiol. u. Planktonkunde 20: 317-320, figs. 23-27. (This treatment is a synonym of *T. naias* [Kirkaldy]).
- (14) *Trichocorixa wallengreni*, Jaczewski, 1930, Mitt. aus dem Zool. Staatsinst. u. Zool. Mus. Hamburg 64: 148.
- (15) *Trichocorixa wallengreni*, Jaczewski, 1931, Ann. Mus. Zool. Polon., Warszawa 9 [15]: 214.
- (16) *Trichocorixa mariae*, Jaczewski, 1931, Ann. Mus. Zool. Polon., Warszawa 9 [15]: 214. (Suggests that *mariae* is a synonym of *wallengreni*).
- (17) *Trichocorixa reticulata*, Jaczewski, 1931, Arch. f. Hydrobiol. u. Planktonkunde 23: 519. (A synonym of *T. naias* [Kirkaldy]).
- (18) *Trichocorixa reticulata*, Lundblad, 1931, Zool. Anz. 96[3-4]: 91. (Exclusive of citations other than Guérin-Ménéville, 1857).
- (19) *Trichocorixa reticulata*, Lundblad, 1931, Zool. Anz. 96[3-4]: 90, 91, 93. (A synonym of *T. naias* [Kirkaldy]).
- (20) *Trichocorixa mariae*, Lundblad, 1931, Zool. Anz. 96[3-4]: 91, 93.
- (21) *Trichocorixa wallengreni*, Lundblad, 1931, Zool. Anz. 96[3-4]: 90, 91, 92.
- (22) *Trichocorixa wallengreni*, Hutchinson, 1931, Amer. Nat. 65: 573-574.
- (23) *Trichocorixa wallengreni*, Jaczewski, 1933, Ann. Mus. Zool. Polon., Warszawa 9 [21]: 337.
- (24) *Trichocorixa reticulata*, Jaczewski, 1933, Ann. Mus. Zool. Polon., Warszawa 9 [21]: 338.
- (25) *Trichocorixa wallengreni*, Jaczewski, 1939, Ann. Mus. Zool. Polon., Warszawa 13 [23]: 284.
- (26) *Arctocorixa blackburni*, Williams, 1944, Hawaii. Ent. Soc. Proc. 12 [1]: 195-196, fig. 16. (Excellent illustration of female; also valuable notes pertaining to habits).

## Some New Species of Cerambycidae from the Island of Hawaii (Coleoptera)

By O. H. SWEZEY

(Presented at the meeting of September 10, 1945)

### *Plagithmysus davis* n. sp.

Head black, clothed with fine white pubescence; a distinct white crescent in the dorsal emargination of the eyes. Antennae dull red. Prothorax finely, densely punctured, very dark brown, almost black, with closely appressed fine white pubescence, except the naked longitudinal band including the dorsal crests. Anterior dorsal crest extended forward beyond margin of prothorax; posterior crest broadly rounded. Lateral crests distinct on posterior half of pronotum. Venter of thorax black with white pubescence; a large dense creamy patch of hairs on posterior part of mesopleura, a similar patch anteriorly. Legs dull red with thin white pubescence; apical fourth of femora black; hind tibiae and tarsi black. Elytra dull red, somewhat shining; somewhat transversely rugose on basal half; white pubescence arranged in numerous white flecks of various sizes and shapes, the larger ones along the suture and continuing to the tips of the elytra. Abdomen black with white pubescence. Length to tip of elytra 15-19 mm.

Allied to *zitticollis* and *swezeyi*; of larger size. The pronotum lacks the dense pronotal vittae. The flecks of white hairs on the elytra are much more numerous.

Described from three males collected by Mr. Clifton J. Davis, ranger at Hawaii National Park, from dead and dying trees of *Diospyros ferrea* at 2000 feet elevation in the vicinity of Puu Waawaa on the lower eastern slope of Mt. Hualalai, Hawaii, March 23, 1945. It is a pleasure to name this interesting new species for the collector, who is greatly interested in the insect faunas of the trees in the Hawaii National Park. (Later, 16 more specimens, both sexes, were reared from the same source.)

Holotype male in the collection of the Hawaiian Entomological Society. Paratypes in the collection of Experiment Station, H.S.P.A., and in the collection of the Hawaii National Park, and in the Bishop Museum.

### *Neoclytarlus dodonaeae* n. sp.

Male 9 mm., female 14 mm. Black, with a clothing of appressed white pubescence on dorsum and also ventrally. Pronotum with a narrow median bare streak somewhat widened in the region of the anterior single transverse crest and in the region of the two posterior transverse crests; a wider similar bare streak towards each side, anteriorly and posteriorly situated on slight elevations; a considerable bare area on lateral area of pronotum, anteriorly a small bare spot between this and the dorsolateral bare streak. Elytra with the white clothing not divided transversely into areas of denser

clothing as in many of the species of *Neoclytarlus*; humeri with elevated rounded bare ridge extending backward somewhat obliquely towards the suture but not reaching it. The areas designated above as bare appear to be so, but are not entirely, being devoid of the white hairs, yet they have a few black hairs. Antennae darker than is usual in other species of *Neoclytarlus*, nearly black, with a few white hairs on the third and fourth segments. Legs sparsely clothed with white pubescence; femora of the usual *Neoclytarlus* type, the enlarged apical portion nearly black, slender portion of femora paler; posterior femora reaching about to 0.8 of elytra in female, nearer to apex of elytra in the male. The club of hind femur is proportionately slightly more thickened in the male than in the female.

Described from a male and female reared from *Dodonaea viscosa* var. *spathulata*, collected at 6400 feet elevation on the Mauna Loa truck trail, Hawaii, August 25, 1945, by Cifton J. Davis, ranger in Hawaii National Park.

Holotype male and allotype female deposited in the type collection of the Hawaiian Entomological Society. Paratypes in collection of Experiment Station, H.S.P.A.

This is the twenty-seventh species of *Neoclytarlus* in Hawaii, eleven of which have been discovered and described since the publication of the Fauna Hawaiiensis.

Later note: Four more specimens issued October 1-6 from a section of partially dead trunk of *Dodonaea* collected at the place mentioned above and sent to me by Mr. Davis. Also, Mr. Davis reared eight beetles Oct. 20 to 27 from *Dodonaea* from the same locality, and contributes the following notes on the distribution of this species of *Neoclytarlus*:

"Highest elevation found—6400 ft. (original discovery) on both sides of Mauna Loa truck trail.

"Lowest elevation found—4500 ft. near Maunaiu water tanks, Ohaieka.

"Optimum range—4900 to 6400 ft. elevation. This is quite obvious as one finds numerous signs of it in this range.

"With the exception of 6400 ft., it is found in isolated kipukas down to 4500 ft. on the west side of the Mauna Loa truck trail.

"Host range—The host plant is abundant and widespread throughout the Park from 8000 to 1500 ft. The optimum development of the hostplant appears to occur between 5000 and 5500 ft. Here these trees attain the height of between 25 to 30 feet and a diameter of 6 to 8 inches.

"I have not found the beetle or signs of it from 6500 to 8000 ft. Nor have I found it in the southern portion of the Park, from Kipuka Nene to Hilina Pali (3000 to 2000 ft.) nor in the Pohio-keawe region through the lands of Keauhou, Kahue, Apua, and a portion of Kealakomo."

***Neoclytarlus mezoneuri* n. sp.**

Female. Black, with a sparse clothing of white appressed setae on head, prothorax, elytra, also ventrally, having no pattern of arrangement into denser patches or streaks as is usually the case in related species of *Neoclytarlus*. Antennae dark brown, with the apices of some segments blackish. Prothorax and elytra dull, densely rugosely punctured. Prothorax with the usual median transverse crests: a large single one anteriorly, and two smaller ones posteriorly. Legs with the club of femora black or dark brown; the slender portion of femora, tibiae and tarsi paler. Posterior femora extend a little beyond the tips of the elytra. Length to tip of elytra 8 mm.

Described from a single female which Mr. Davis reared November 11, 1945, from wood of *Mezoneurum kauaiense* collected by A. L. Mitchell in the Puu Waawaa region, on the northeast slope of Mt. Hualalai, Hawaii.

Holotype in the type collection of the Hawaiian Entomological Society.





## New Species of Hawaiian Lepidoptera

By O. H. SWEZEY

(Presented at the meeting of December 10, 1945)

Herewith are presented the descriptions of a number of new species of Hawaiian moths which have been reared from time to time or otherwise discovered in working over collections, and set aside for the time being awaiting description (on account of there being but a single specimen, or because the material at hand was not in perfect enough condition) in the hope that more and better material might yet be obtained from which to make descriptions. However, it seems best now to put some of these on record without further waiting.

The family names used for the Microlepidoptera herein are as adopted by Mr. August Busck in a revision of Hawaiian Microlepidoptera which he had under way at the time of his demise.

The types are in the type collection of the Hawaiian Entomological Society.

### Family PYRAUSTIDAE

#### *Phlyctaenia campylothea* n. sp.

Male, female. 16-20 mm. Head, palpi, antennae and thorax ferruginous; palpi 3-3½, white beneath at base. Abdomen slightly paler ferruginous, anal tuft of male ochreous, ferruginous at base. Forewings ochreous ferruginous, varying in the intensity of the ferruginous tint; round orbicular and eight-shaped discal spots outlined with fuscous, obscure in the specimens with most intensely ferruginous-tinted wings, in which also the first and second lines are obscure; in specimens with less intensely ferruginous wings the lines are fuscous and of the usual form for *Phlyctaenia*; a terminal series of very small dots; cilia fuscous, white tipped. Hindwings light fuscous, darker terminally; two obliquely placed darker discal dots, often obscure; postmedian line obsolete, or occasionally indicated; a terminal series of minute fuscous dots, often obscure; cilia whitish with basal half fuscous, or sometimes nearly entirely fuscous.

The most intensely ferruginous specimens which were assembled by Meyrick in *despecta*, which he treated of as a very variable species, I would place in *campylothea*, named for the food plant from which all of my specimens were reared. Formerly *Campylothea* included a large number of Hawaiian species of plants which are now recognized as *Bidens* by the botanists.

Reared from foliage of *Bidens* (*Campylothea*), Palolo Valley, Oahu, October 6, 1906, December 13, 1908; Niu ridge, Oahu; November 11, 1906; Mt. Olympus, Oahu, January 21, 1912 (Swezey); Mt. Konahuanui, Oahu, July 23, 1916 (Timberlake); Kumuweia,

Kauai, August 28, 1921 (Swezey); Haleauau Valley, Oahu, January 16, 1932 (Swezey).

**Phlyctaenia phyllostegia** n. sp.

Male. 19 mm. Head, palpi, antennae and thorax pale brownish ochreous; antennae whitish beneath, palpi  $3\frac{1}{2}$ , white beneath. Abdomen ochreous, with apical segmental margins white, anal tuft white. Legs ochreous, anterior tibiae dark fuscous basally, middle tibiae with fuscous longitudinal line above, tarsi somewhat infuscated. Forewings pale brownish ochreous; costa with four fuscous spots on apical half; roundish orbicular and discal spots outlined with fuscous, the discal larger; first line wavy, indicated by fuscous scales, extending nearly vertically from orbicular to dorsum; second line wavy, indicated by fuscous scales vertically from second fuscous costal spot to vein three, then a wide loop extends basally to below discal spot then about parallel to dorsum terminating about midway between first line and tornus; eight conspicuous fuscous terminal spots between veins; cilia concolorous. Hindwing pale brownish ochreous, darker on the apical third; two obliquely placed fuscous discal dots; an obscure fuscous postmedian line from a fuscous dot on costa; a terminal series of fuscous dots; cilia somewhat paler than terminal area of wing.

This species has considerable resemblance to *Pyrausta thermantis* Meyr. in which however, the forewing is ferruginous, the loop of second line beneath discal spot is narrower, and the terminal dots are smaller.

A single specimen reared from leaves of *Phyllostegia* sp., Pacific Heights ridge, Oahu, March 3, 1912 (Swezey).

Family TORTRICIDAE

**Tortrix lysimachiana** n. sp.

Female. 16 mm. Head and thorax brownish fuscous. Palpi brownish fuscous about 3, middle joint long, terminal joint very short. Antennae brown, about  $\frac{3}{4}$ . Forewings brownish fuscous, a series of darker spots on costal and dorsal margins; a medium wide irregular-margined darker band extends outwardly oblique from  $\frac{1}{3}$  of costa to the fold, the margins are indicated by a few black scales outside of which a pale line; a few scrawly black marks in outer part of wing; cilia pale, barred with fuscous. Hindwings pale gray, darker terminally and with scattered slightly fuscous spots which are more conspicuous on the under surface; cilia pale, fuscous on basal half. Abdomen ochreous. Fore and middle legs brown, tarsi spotted with ochreous. Hindlegs ochreous, tarsi spotted with fuscous.

Described from a single specimen reared from foliage of *Lysimachia rotundifolia*, Puu Hapapa, Waianae Mts., Oahu, January 16, 1927 (Swezey).

**Epagoge osteomelesana** n. sp.

Female. 9 mm. Head and thorax pale fuscous, the scales tipped with white. Head rough scaled; palpi 2, second segment rough scaled, whitish, terminal segment short, black. Antennae fuscous, about  $\frac{1}{2}$ . Forewings white with numerous fuscous strigulae; costa with a series of dark fuscous spots, those on basal half small, on the apical half larger and from three or four of them are outwardly-oblique bars, the one from middle of costa connected with a longitudinal fuscous streak in outer portion of cell; at apex is a larger dark fuscous costal spot with a tapering extension dorsally to about middle of

termen, between this dark spot and the cell is a white area almost free of strigulae, but with some fuscous scales on its dorsal side, most distinct anteriorly. Cilia white and fuscous mixed. Hindwings nearly uniformly pale brownish, slightly darker terminally, and without markings; cilia gray, whitish mixed towards apex. Legs whitish, fore and middle tibia and all tarsi fuscous marked. Abdomen very pale brownish.

A single specimen reared from *Osteomeles anthyllidifolia*, Woodlawn, Manoa Valley, Oahu, November 18, 1929 (Williams).

#### Family COSMOPTERYGIDAE

##### *Petrochroa communis* n. sp.

Male, female. Expanse 9-10 mm. Head and thorax white, some of the scales tipped with black. Palpi white, externally spotted with black, second segment black at apex, terminal segment black-tipped. Antennae black, basal joint white speckled with black, with pecten ventrally, flagellum in male slightly serrated. Fore and middle legs fuscous, hind legs mostly whitish. Abdomen dirty white, ringed with fuscous, anal tuft of male creamy white. Forewings white with many of the scales tipped with black giving a gray appearance, an elongate black spot occupying about the middle fifth of the fold, two or three scattered similar spots between the spot in the fold and the costa, sometimes a black streak between the cell and the termen; cilia gray, two black spots in costal cilia just before apex. Hindwings nearly uniformly gray, cilia pale gray. The venation varies somewhat from that of the genotype in that vein 6 of forewings is sometimes separate from 7 + 8; also in the hindwings 6 is usually separate from 7; frenulum in female consisting of 4 spines.

Taken at light, Kaimuki, Oahu, various times, 1908 to 1915 (Swezey); and Kokee, Kauai, August 29, 1921 (Swezey). Taken commonly in light traps at several locations in the Pearl Harbor region, Kaneohe, and in Honolulu, Oahu, 1944 and 1945.

#### Family CALOPTILIIDAE

##### *Parectopa lipochaetae* n. sp.

Male, female. 5-6 mm. Head white; palpi white, second segment with a black dot at apex, third segment with a black dot near tip; antennae white beneath, ringed with fuscous above. Thorax white. Abdomen whitish, anal tuft of male white. Legs white, forelegs and middle legs and posterior tarsi spotted with black. Forewings with ground color pale fawn, but appearing mostly white on account of the white streaks arranged as follows: three costal very outwardly-oblique and two dorsal which join the first and second costal in middle of wing; the two dorsal streaks are wide at base, the first one following dorsal margin to base of wing, the wide base of the second dorsal extends nearly to the tornus; the third costal streak reaches about half or a little more across the wing, straight and not quite parallel with the second costal streak; sometimes a white median streak in basal portion of wing; three short white streaks on costa near apex; a round black spot situated in terminal white area; all white streaks bordered by black scales and a line of black scales on termen at base of cilia. Cilia white, outer half fuscous. Hindwings and cilia slightly infuscated.

In its markings near related to *marginestrigata*. Reared from leafminer in *Lipochaeta lavarum*, Lahaina, Maui, December 23, 1928 (Swezey).

**Parectopa nigrelloides n. sp.**

Male (?). 8 mm. Head and thorax brownish fuscous; palpi white above, blackish beneath; antennae black. Thorax and abdomen white below. Legs pale brownish, tarsi spotted with white. Forewing bronzy brown; an outwardly oblique white bar from  $\frac{3}{4}$  of costa, extending about  $\frac{2}{3}$  across wing; a few white scales on dorsum near base; at  $\frac{2}{3}$  of dorsum an outwardly oblique white streak extends to about middle of wing, wider at base and tapering to a point; a smaller white streak at  $\frac{2}{3}$  of dorsum; in terminal area of wing a blue spot with black center; near apex of costa three spots, the first one larger, separated by black spots; cilia concolorous with the white and black spots; terminal cilia fuscous, pale at base where they join a line of black scales marking the terminal border, ternal cilia fuscous.

A single specimen reared from mine in leaf of *Dubautia* sp., Alakai Swamp, 4,000 ft., Kauai, August 22, 1921 (Swezey). Resembles *Philodoria nigrella* Walsm. from Kilauea, Hawaii; but it has maxillary palpi, which are absent in the genus *Philodoria*.

Synonymic Notes on *Argyroploce illepida* (Butler) and  
*A. carpophaga* (Walsingham)  
 (Lepidoptera: Eucosmidae)

By O. H. SWEZEY and ELWOOD C. ZIMMERMAN

(Presented at the meeting of September 10, 1945)

A. NOTES BY O. H. SWEZEY

This eucosmid moth, known in Hawaii as the koa seed moth on account of the heavy infestation of koa seeds by its larvae, was described by Butler as *Teras illepida*. The description is from a single specimen collected by the Rev. Thomas Blackburn: "In neighborhood of Honolulu; rare.—T.B." In the description the sex is not stated, but it more nearly agrees with the male as we know it at the present time.

Walsingham (Fauna Hawaiiensis, 1 [5]: 681, 1907) placed the species in the genus *Cryptophlebia* which he had erected for *carpophaga*, a species described from India (Indian Museum Notes 4: 105, 1899). Apparently the genus is named for a character in the hindwing of the male: "A pouch-like fold along vein 2, containing a thick tuft of scales on the upper side, accompanied by some strongly curved scales on the underside along the margin." This character is common to both *illepida* and *carpophaga*.

Then Meyrick (Records of the Indian Museum, 5: 218, 1910) removed *illepida* to the genus *Argyroploce* and placed *carpophaga* as a synonym of *illepida*, the latter having priority of publication. It would seem that the character on which the genus *Cryptophlebia* was based was sufficient to maintain it as a good genus. This character is not used in the description of the genus *Argyroploce*, a genus of over 500 species. However, in this large genus Meyrick has described a large number from many regions, and among them quite a number have various kinds of secondary characters in the hindwings of the males. It would necessitate many more genera if each of these various characters were used as a basis for separate genera. Hence, no doubt Meyrick is fully warranted in placing *illepida* and *carpophaga* in *Argyroploce*, instead of leaving them in an isolated genus. Fletcher has also adopted this usage (Some South Indian Insects, p. 449, 1914).

When in Guam in 1936, I reared a good series of moths from the seeds of several leguminous trees, which agree with Walsingham's description and figure of *carpophaga*, and I noted differences between these specimens and those reared in Hawaii from seeds of *Acacia koa*, *Acacia farnesiana* and several other leguminous trees,

but not from *Poinciana regia*, *Adenanthera pavonina* and *Pithecolobium dulce* all of which had their seeds badly infested by *carpophaga* in Guam. Hence, I must take exception to Meyrick's synonymy, and consider the two as different species, irrespective of the fact that he states: "Having obtained a series of the Hawaiian from [*illepida*], I find it is identical with Australian, Indian and South African examples [*ombrodelta* and *carpophaga*]."

Some of the differences are as follows: The male of *carpophaga* has much more long woolly hair on dorsum of abdomen; the large tufts on posterior tibia and enlarged basal joint of tarsus are blackish, whereas in *illepida* they are ochreous; the dorsal portion of forewing beneath the fold is infuscated and with a slight admixture of bone-grey scales in *carpophaga*, but not so in *illepida*; in forewing a triangular dark spot near the tornus having its base on dorsum in *carpophaga*, absent in *illepida*; cilia of hindwing white in *illepida*, grey in *carpophaga*. There are 24 males in my Guam series, which I have compared with a series of 40 *illepida* males. The females do not exhibit such striking differences. In both species the forewings vary in the degree of coloration: tawny, ferruginous or brown, but both have the triangular darker spot near the tornus.

So far as known to me, *illepida* does not occur anywhere except in the Hawaiian Islands, and any records in literature of its occurrence elsewhere, no doubt should be considered as belonging to the true *carpophaga*.

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*Cryptophlebia illepida*, Walsingham, Fauna Hawaiiensis, 1 (5): 681, pl. X, 23-25, 1907.  
*Argyroploce illepida*, Meyrick, Records of the Indian Museum, 5: 218, 1910.  
*Argyroploce illepida*, Fletcher, Some South Indian Insects: 449, 1914.

#### B. NOTES BY E. C. ZIMMERMAN

In the foregoing note, Dr. Swezey has outlined his reasons for believing that the moth *Argyroploce illepida* (Butler) of Hawaii is distinct from the widespread *A. carpophaga* (Walsingham). His conclusions are based upon studies of the food habits and external features of the moths. He has asked me to make a study of the genitalia of the species, and I am glad to report that the results of the examination of the male genitalia fully support his conclusions.

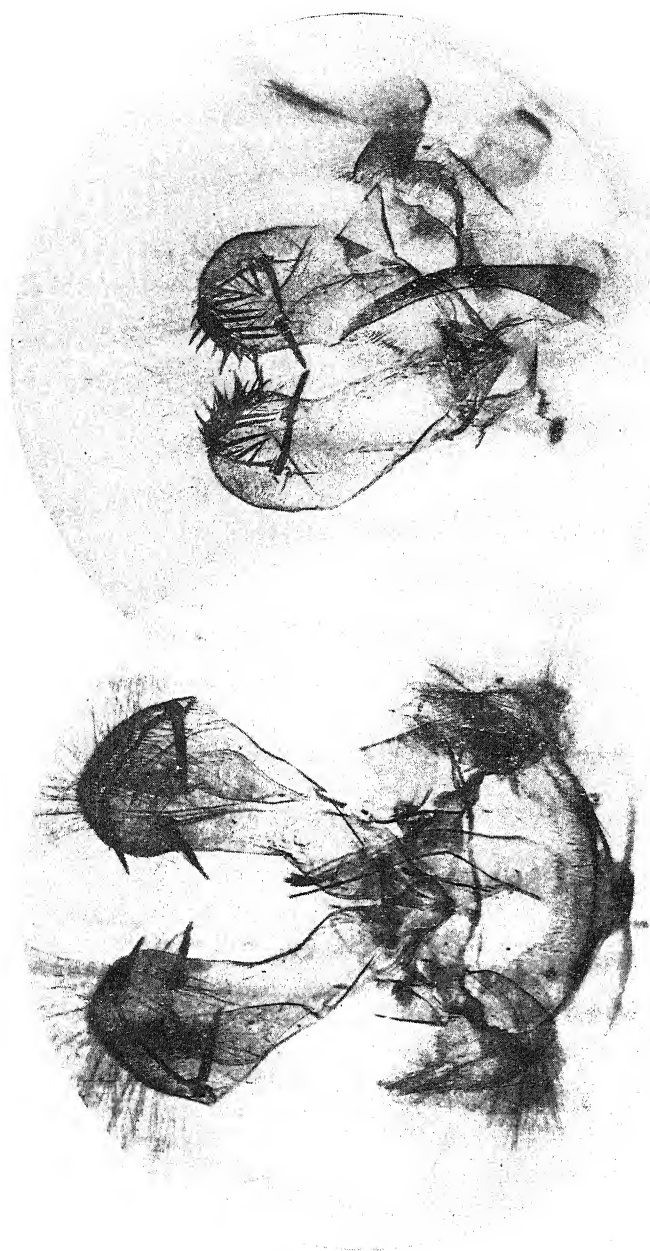


Figure 1.—Left: Photograph of the genitalia of a male *Argyroproct carphoga* (Walsingham) collected at light at Piti, Guam, July 12, 1936, by O. H. Swezey. Right: Photograph of the genitalia of a male *Argyroproct illeptida* (Butler) collected at Kaimuki, Oahu, T. H., April 17, 1908, by O. H. Swezey.





Herewith are presented reproductions of photographs (kindly made for us by Mr. D. M. Weller, histologist at the H.S.P.A. Experiment Station) which show, without the need of further explanation, how easily the two species may be distinguished on the basis of the male genitalia alone. There is no question that *Argyroploce illepida* is fully distinct from *A. carpophaga*.

An additional problem which we have considered is the status of the two varieties of *Argyroploce illepida* and the two separate species described by Walsingham from Hawaii.

In the series of this common moth (*illepida*) before us, there is a great range of size (12 to nearly 25 mm.), color and color pattern. Slides of the male genitalia of 10 examples from different places, collected free or reared from *Acacia confusa*, *Acacia koa*, *Pithecolobium*, *Dodonaea* and *Sapindus*, and mostly showing differences in color pattern, have been examined. In spite of size and color differences, the structure of the genitalia of all specimens studied is remarkably uniform.

It is of interest to note that Walsingham had 15 examples of his *illepida fulva*, only one of *illepida suffusa*, two damaged *tetrao* and a unique of *vulpes*. If one wished to describe color variations, a number of new ones could be erected from the variable series now available. Perhaps Walsingham would not have proposed so many names if he had been supplied with a more representative series of examples and if he had been more acquainted with the bionomics of the species.

From the evidence now at hand, it appears that there is only one species of *Argyroploce* in Hawaii, and the following synonymy is indicated:

### ***Argyroploce illepida* (Butler)**

*Teras illepida* Butler, Trans. Ent. Soc. London, p. 42, 1882.

*Cryptophlebia illepida illepida* (Butler) Walsingham, Fauna Hawaiiensis, 1 (5): 681, pl. 10, fig. 23, 1907.

*Cryptophlebia illepida* var. *fulva* Walsingham, loc. cit., pl. 10, fig. 24. New synonym.

*Cryptophlebia illepida* var. *suffusa* Walsingham, op. cit., p. 682, pl. 10, fig. 25. New synonym.

*Cryptophlebia tetrao* Walsingham, op. cit., p. 683, pl. 10, fig. 26. New synonym.

*Cryptophlebia vulpes* Walsingham, loc. cit., pl. 10, fig. 27. New synonym.

*Argyroploce illepida* (Walsingham) Meyrick, Records Indian Museum, 5: 218, 1910.



Notes and Descriptions of *Ceratocombus*  
(Hemiptera: Cryptostemmatidae)

By ROBERT L. USINGER

U. S. Public Health Service

(Presented at the meeting of December 10, 1945)

Several interesting cryptostemmatids have come to hand during the past two years, both from my own collecting and from material submitted for identification. The new records and species of *Cryptostemma* have been described elsewhere (Usinger, Ent. News, 56: 238-241, 1945). In the present paper a new record is given for *Ceratocombus vagans* McAtee and Malloch, and new species of *Ceratocombus* are described from Puerto Rico and Hawaii. I am indebted to E. C. Zimmerman and R. I. Sailer for the opportunity to study the Hawaiian specimens. These are of particular interest because they represent the first collection of Cryptostemmatidae from the Hawaiian Islands.

*Ceratocombus* (*Xylonannus*) *vagans* McAtee and Malloch, 1925

This species was originally described from Maryland with paratypes from Washington, D.C., Virginia, New York, Florida and Panama. Barber (1939)\* reported it from Puerto Rico. Uhler's *niger* (1904) from New Mexico was doubtfully referred here by McAtee and Malloch and they suggested that Champion's *panamensis* (1900) may prove to be the same when the type is studied in this connection. I am now able to add Georgia to the list and record another locality for Puerto Rico.

One macropterous female and numerous nymphs were taken amidst loose frass beneath the bark of a decaying tree near the summit of Brasstown Bald (approximately 4500 feet elev.), Georgia, Sept. 10, 1944 (R. L. Usinger).

Both macropterous and brachypterous specimens were very abundant on the ground beneath leaf mold and numerous small fruits of a fallen Sierra palm near the summit of El Yunque, Puerto Rico, April 29, 1945 (R. L. Usinger).

*Ceratocombus* (*Xylonannus*) *hawaiiensis* Usinger, new species

Suboval in form and rather uniformly brownish to castaneous in color.

Head one-third broader, eyes included, than long, 12::9. Eyes one-fourth as wide as interocular space, 2::8. Vertex smooth, moderately convex.

\* Dates in parentheses refer to the bibliography at the end of the paper. [Ed.].

Proc. Haw. Ent. Soc., Vol. XII, No. 3, May, 1946.

Clypeus broad, parallel-sided and slightly inflated. Rostrum surpassing posterior coxae, the proportion of segments  $2:9\frac{1}{2}:7\frac{1}{2}$ . Antennal proportions  $2:5\frac{1}{2}:9:9$ .

Pronotum over twice as broad across humeral angles as long on median line,  $17::8$ , and slightly shorter than head,  $8::9$ . Disk only moderately convex, smooth, the anterior collar marked by a transverse impression laterally behind eyes, briefly transversely foveate anteriorly at middle. Lateral margins feebly rounded, sinuate at anterior constriction. Posterior margin broadly, deeply concave.

Scutellum broader than long,  $9::7$ , subflattened and impressed with two minute foveae near middle; sides nearly straight to acute apex.

Hemelytra presumably complete, the distance from tip of clavus to apex of membrane greater than distance from base of corium to tip of clavus,  $16::14$ . Venation as in *vagans* McAtee and Malloch, but with the two apical cells equal in size.

Under surface as in *vagans*, the male genitalia agreeing with the illustrations of McAtee and Malloch and with Puerto Rican specimens of *vagans*.

Color uniformly pale brown, the hemelytra translucent, the eyes reddish, anterior portion of head and appendages pale. Under surface brown to ochraceous.

Size: Length 1.3 mm., width (pronotum) 0.5 mm. (hemelytra) 0.62 mm.

Holotype, macropterous female, Waipahee, Kauai, T. H. Jan. 13, 1944, under bark of dead tree (N. L. H. Krauss). Allotype, male, and one female paratype, macropterous, same data as type. The holotype and allotype are deposited in B. P. Bishop Museum, Honolulu, T. H.

*Hawaiiensis* is similar to *vagans* in every way except for the form and proportions of the head and pronotum. These proportions differ strikingly in the two forms of *vagans* as follows: brachypterous form—head scarcely broader than long,  $11::10$ ; eyes small, one-fourth as wide as interocular space,  $2::8$ ; pronotum strongly convex, nearly parallel-sided, less than twice as broad as long; macropterous form—head distinctly broader than long,  $10\frac{1}{2}::8$ ; eyes larger, nearly half as wide as interocular space,  $2\frac{1}{2}::6$ ; pronotum twice as broad as long,  $14::7$ .

In *hawaiiensis* the eyes are small as in brachypterous *vagans* while the head is relatively broad as in macropterous *vagans*. The pronotum is even wider than in macropterous *vagans* and has convex side margins in contrast to concave margins in *vagans*. In general appearance the head of *hawaiiensis* is more robust and less strongly narrowed in front of the eyes and the pronotum is broad with sides convex. These characteristics served to distinguish *hawaiiensis* from the long series of specimens of *vagans* which I studied in the U. S. National Museum collection.

***Ceratocombus (Ceratocombus) yunquensis* Usinger, new species**

Elongate-oval, attenuated anteriorly, the surface above opaque, black, distinctly marked with a yellow longitudinal fascia on inner half of each corium, these fasciae almost or quite joining an arcuate fascia which crosses apices

of coria and base of membrane. Hairs on upper surface, except head, very short and sparse, confined to margins and to veins of hemelytra.

Head broader than long, 12::9; the eyes, seen from above, about one-third as wide as interocular space,  $2\frac{1}{2}$ ::7; eyes touching anterolateral angles of pronotum; ocelli contiguous with inner margins of eyes; surface smooth, impunctate, naked and slightly convex basally; transversely wrinkled and beset with long, curved hairs apically. A long bristle behind each ocellus and another near front of eyes. Rostrum reaching to middle of intermediate coxae, the proportion of segments 3:8:7. Antennae as long as head, pronotum, and scutellum together, the proportion of segments as  $2\frac{1}{2}$ :5:10:9.

Pronotum over twice as broad behind as long on median line, 18::8, and slightly shorter than head, 8::9 $\frac{1}{2}$ ; anterior collar obscure except near depressed anterolateral angles, lateral margins straight, with a prominent, anterolaterally directed bristle at anterior fourth; front margin slightly concave, hind margin broadly concave.

Scutellum broader at base than long, 12::9, feebly convex, the sides sinuate, subacute at apex.

Hemelytra complete, very long and broadened apically, the membrane almost as long as corial margin and four-fifths as wide. Corial margin scarcely arcuate, the disk subflattened laterally, convex on inner two-thirds, apex narrowly deflected beyond brief fracture. Venation as figured by McAtee and Malloch for *areolatus* except that the outer vein emanating from discal cell does not curve outward toward cuneal fracture but continues straight to wing margin.

Color dull to glossy black above with ochraceous anterior two-thirds of head, a bright yellow fascia arising at base of corium and continuing along inner corium, occupying the greater part of inner corium between emboliar and claval sutures. The yellow extends to embolium and outer clavus at extreme base. Apically the fascia narrows abruptly or is briefly interrupted before transverse apical fascia. The latter arises at and just beyond subapical fracture. It does not reach apex of corium at lateral margin but extends broadly inward and crosses apical margin of corium on inner half, thence continuing across base of membrane. Membrane pale smoky white along outer margin. Rostrum and first two antennal segments pale, apical antennal segments brown. Under surface of head reddish-ochraceous, elsewhere brownish with pale pubescence, the legs pale with brown at middle of coxae and femora.

Size: Length 1.7 mm., width (pronotum) 0.52 mm. (hemelytra) 0.8 mm.

Holotype, female, and two female paratypes, Sierra palm forest, El Yunque, Puerto Rico, April 29, 1945 (R. L. Usinger). These specimens were taken beneath leaf mold and numerous small fruits of a fallen Sierra palm in company with the much more abundant *Ceratocombus vagans*. The holotype is deposited in the U. S. National Museum.

*Yunquensis* is closely related to *fasciatus* Uhler from Grenada and St. Vincent, but differs from that species in hemelytral markings and in its larger size. It runs to *brasiliensis* Reuter in McAtee and Malloch's key, but that species lacks the distinctive yellow fasciae. *Bifenestratus* Poppius (1910) from the island of Guadeloupe also belongs near here but lacks the distinctive markings of *yunquensis*.

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***Psychoda pseudalternata* n. sp. (Diptera: Psychodidae)**

By **FRANCIS X. WILLIAMS**

Experiment Station, H.S.P.A.

(Presented at the meeting of June 11, 1945)

Some years ago the B. P. Bishop Museum, Honolulu, sent to Dr. A. L. Tonnoir a number of *Psychoda* flies for determination. Dr. Tonnoir died before completing his work; he did, however, recognize a new species in the collection, specimens of which he had recently collected in Canberra, Australia. This species he named *Psychoda pseudalternata* and he returned specimens so labelled as paratypes, to the Bishop Museum, as well as including specimens of the same species taken at Canberra.

Since Dr. Tonnoir, as far as can be ascertained, has not published a description of this insect, it rests upon myself to give further data upon it. I figured (Proc. Haw. Ent. Soc., 11: 336, 1943) the male terminalia of *Psychoda pseudalternata*, as well as of *Psychoda alternata* Say (l.c.: 334), both from specimens determined by Dr. Tonnoir. I can only state that *Psychoda pseudalternata* is close to *P. alternata*, but the former has the spinule of the inferior appendage of the terminalia broadened, subspatulate towards the apex and the margin oblique there, while in *P. alternata* this spinule is only moderately widened but somewhat curved apically. There are no specimens of *Psychoda alternata* females determined by Dr. Tonnoir in the collections here.

The specimen now designated as lectotype bears the label *Psychoda pseudalternata* ♂ paratype Tonn., Canberra, A. C. T., April 1939. A. L. Tonnoir. A ♀ syntype bears the same data. Other syntypes (paratypes) are: One ♀, Manoa Valley, Honolulu, Feb. 3, 1934, at light (Carl T. Schmidt); one ♀ and one partly dissected specimen, Honolulu, Oahu, March 25, 1923, Quarantine Island (S. C. Ball), glued on a card with other specimens but set off from these by an ink-lined square. The lectotype and all the syntypes are in the collection of the B. P. Bishop Museum.

I am indebted to Dr. Alan Stone of the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, U. S. Dept. Agriculture, for calling my attention to the status of this insect.





**Stigmatomma (Fulakora) zwaluwenburgi, a New Species of  
Ponerine Ant from Hawaii**

By **FRANCIS X. WILLIAMS**

Experiment Station, H.S.P.A.

(Presented at the meeting of September 10, 1945)

In February 1941, Mr. R. H. Van Zwaluwenburg discovered four workers of this ant while searching for tiny hypogaeic carabid beetles in soil obtained from a field of sugar cane at the Experiment Station, H.S.P.A., Honolulu. A fifth specimen (the paratype) was taken by the writer on October 26, 1945 in moist soil from the same field.

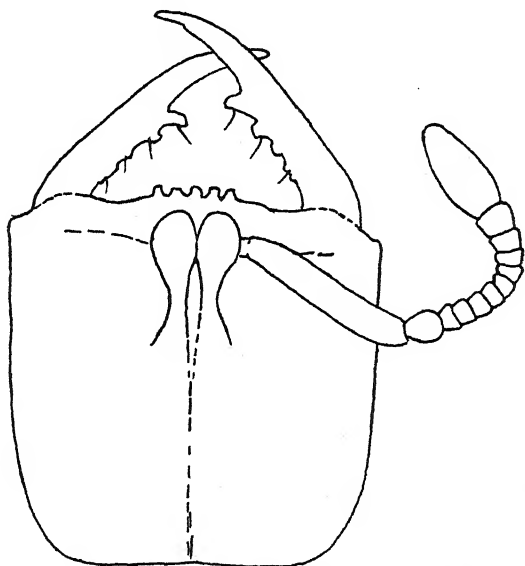


Figure 1.—*Stigmatomma (Fulakora) zwaluwenburgi*, type.

***Stigmatomma (Fulakora) zwaluwenburgi* n. sp.**

Type: Length 1.80 mm. Head as broad at clypeus as long; occiput shallowly concave; fronto-occipital suture not strong; clypeus in front armed with five rather blunt denticles. Mandibles with the thickened basal portion bearing five simple teeth, the basal one quite small; one subapical denticle. Frontal lobes touching rather narrowly, their carinae feeble and diverging behind. First and apical funicular joints longer than broad. Eyes wanting. Thoracic dorsum and epinotum flat. Prothorax a little longer than broad,

gently rounded. Promesonotal suture strongly impressed. Mesonotum more than twice as broad as long, the sides nearly straight. Mesoepinotal suture indistinct. Epinotum gradually widening from base, about as broad as long to ventral apex, the declivity transverse, generally smooth, the sides strongly margined. Petiole narrower than first gastric segment, rounded in front and more slightly so at the sides. Gaster slender, legs stout.

Head and thorax sublucid, epinotum and gaster more shining. Mandibles with some rugae. Head and thorax densely granulose, thoracic dorsum and epinotum with some subobsolete carinulae, gaster with more separate punctures.

Color rufo-testaceous, the head a little darker; pilosity whitish.

The paratype is approximately 1.75 mm. long from the apical part of the clypeus; there are four somewhat recurved teeth on the inner side of the mandibles, the basal teeth being short. The clypeus has the five bluntly conical teeth on its margin.

Type and paratype in the collection of the Hawaiian Entomological Society.

Three of the five specimens collected are not now available.

The subgenus *Fulakora* was erected by Mann for *Stigmatomma* (*Fulakora*) *celata* from the British Solomon Islands. It—"is proposed for those species of *Stigmatomma* that have the frontal lobes approximate, instead of widely separated." (The Ants of the British Solomon Islands. Bul. Mus. Comp. Zool., 63 [7]: 279-280, 1919).

This subgenus has representatives in Australia, New Zealand, Sumatra, Philippines, Hawaii, Cuba, Brazil, Argentina, and no doubt elsewhere.

*S.* (*Fulakora*) *zwaluwenburgi* differs from its apparently nearest relatives, *S.* (*Fulakora*) *celata* Mann from the British Solomon Islands and *S.* (*Fulakora*) *minuta* Forel from Sumatra (Zool. Jahrb. systematik, 36: 4-5, 1914) chiefly in having the head quite as broad as long and in having the clypeus provided in front with five teeth, *Stigmatomma* (*Fulakora*) *celata* and *minuta* each having six teeth.

I take pleasure in naming this species after my colleague, Mr. R. H. Van Zwaluwenburg.

It is presumed that this ant is one of the relics of an earlier Hawaiian ant fauna of which our representatives are chiefly minute ponerines and which may have survived under unfavorable environment because of their hypogaecic habits. (See Wheeler: Revised List of Hawaiian Ants. Bernice P. Bishop Museum, Occasional Papers 10 [21]: 5, 1934).

Two New Species of Astatinae, with Notes on the  
Habits of the Group  
(Hymenoptera: Sphecidae)

By FRANCIS X. WILLIAMS  
Experiment Station, H.S.P.A.

(Presented at the meeting of December 8, 1945)

**Astata immigrans** n. sp. (plates XXXI-XXXIII figures 1-13)

*Female*, holotype: Length 5.5 mm. Of the usual stout form. Black; mandibles testaceous mesad, reddish apically; veins at base of wings and a prestigmatal spot creamy white, remaining venation of fore wings more or less testaceous, venation of secondaries much paler; tibiae, more or less, and tarsi brownish; tegulae and sclerite at costal base of fore wings dark brownish, wings hyaline, abdomen red. Head and thorax generally, very finely coriaceoreticulate, subopaque. Mandibles bidentate, with a few punctures outwardly at base, malar space very short; clypeus with the disc gently convex, with a few large punctures, the margin depressed, narrowly produced mesad into two rounded teeth with a low lobe on either side; antennae with joint 3 considerably longer than 4, 4 slightly longer than 5, the interocular space at vertex being slightly greater than joints 3 plus 4; ocelli arranged nearly in an equilateral triangle, the anterior ocellus very slightly the farthest removed; a small scar that narrows anteriorly, borders the inner margin of the eyes opposite each posterior ocellus; a fine impressed line from anterior ocellus extending more than half way to the base of the clypeus; a few scattered punctures on frons and vertex. Anterior portion of pronotum smooth and shining, scutellum more shining in its anterior portion, metanotum shining, almost smooth; disc of propodeum finely margined, very finely reticulate, although the sculpture is not as fine as that of the thorax proper; there is a delicate carinula at the base and a large shallow subtriangular depression at the apex, the pleura with some fine oblique striae, the posterior face is steep, largely smooth and shining mesad with an oval fovea above. First joint of fore tarsus with a comb of four bristles, the apical bristle the heaviest, and each bristle about twice as long as the diameter of the joint; fore and posterior femora with some long erect hairs beneath. Forewings with the marginal cell very short, only a little longer than high and shorter than the stigma, the poststigmatal part about as long as the substigmatal part; second submarginal cell sessile at the marginal cell, its basal or 1st t.c. border with a stub of a vein mesad; third submarginal cell very short, nearly twice as high as long, the long sides subparallel. Pygidium with the marginal carinae and hair fringe indicated only at apex. Vestiture of sparse pale hair.

*Male*, allotype: Length 5.5 mm. Head and thorax black, abdomen red darkening apically. Pale markings as follows: mandibles widely creamy yellow mesad, a large squarish spot each side before declivity of face, prothoracic lobes, tegulae and veins at base of wings creamy white; apex of femora quite narrowly, (and obscurely in the posterior femora) and the fore tibiae and tarsi generally, pale yellowish to yellowish brown, base and apex of tibiae 2 and 3 less obviously pale. Mandibles bidentate at apex and a low wide tooth on inner margin at base of second apical tooth, malar space not twice as wide as long; clypeus triangularly produced, the apex somewhat attenuated; antennae showing only very slight swellings latero-ventrad at base of 7, 8 and 9. The sculpture is less fine than in the female, the pleura are sprinkled pimple-like with fine granulations; the sides of the propodeum are

not striate, the posterior face is shining with scattered granulae, and the fossa is somewhat more developed than in the female. Pygidial area with a few large punctures; terminalia shown in fig. 11. Vestiture moderate, of erect silvery hair.

*Holotype*: Oahu: Honolulu, at Experiment Station, H.S.P.A., May 24, 1943; on *Portulaca oleracea* Linn. (F. X. Williams). *Allotype*: Oahu: Ewa, July 18, 1939, on *Portulaca oleracea*. (F. X. Williams). *Paratypes*: Ewa, Oahu, 3 ♀♀, August 3 and 4, 1939, 2 ♂♂, July 18, 1939; Honolulu, Oahu, 1 ♂ and 1 ♀, June 19, 1942, 1 ♀ and 4 ♂♂, late May, 1943, and 4 ♀♀ and 2 ♂♂, June, 1943 (reared).

This small species is related to *Astata bella* Cresson (Trans. Am. Ent. Soc. [Proc.] 9: vi, 1881 ♂ "Hab.-San Diego, California").

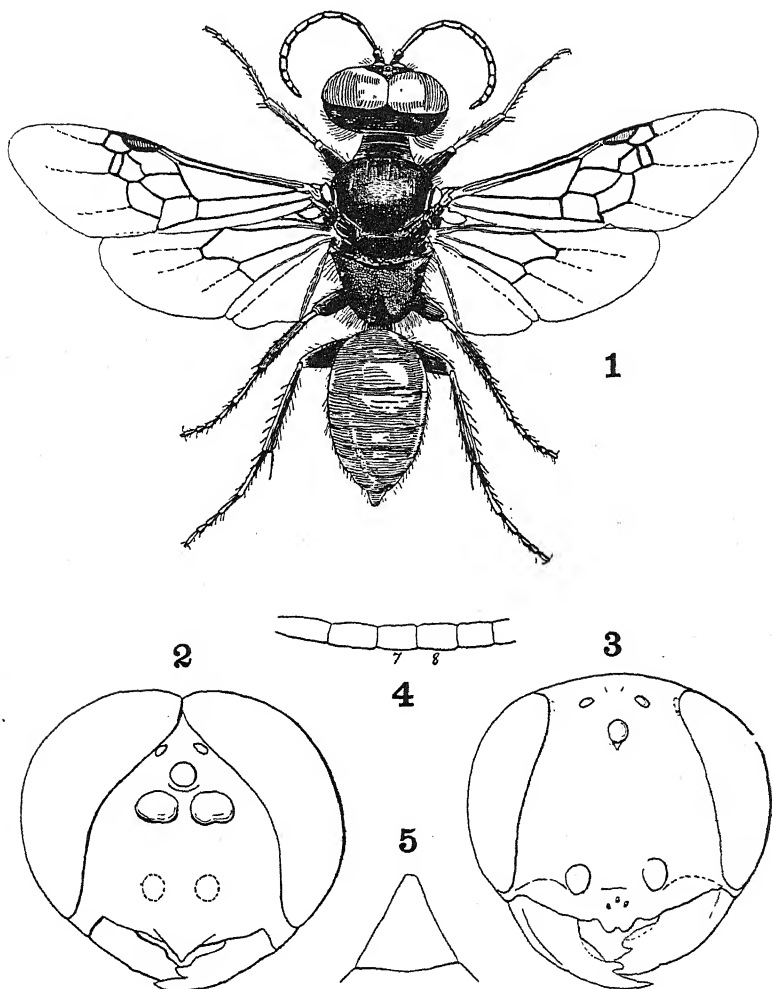
While at the Academy of Natural Sciences of Philadelphia, Mr. P. H. Timberlake of the University of California Citrus Experiment Station, Riverside, California, kindly compared specimens of the *Astata* from Honolulu, Hawaii with the type of *Astata bella* ♂ and of *Astata elegans* ♀.\* Mr. Timberlake believes that the *Astata* from Hawaii—which I describe as *A. immigrans*—is different from *A. bella*, and I quote from his notes taken in Philadelphia: Comparing *A. bella* Cress., type ♂, "Cal.": "Differs from the Honolulu ♂ in having the white spots on frons extending upward each side of anterior ocellus. Eyes more broadly touching on vertex."—"Poststigmatal part of marginal cell nearly twice as long as the substigmatal part (the two parts nearly equal in the Honolulu species). The type has the tegulae and tubercles white. Wings with a faint cloud across marginal, second and third submarginal cells."

Comparing *Astata elegans* Cress., type ♀, "W.T.": "Differs from the Honolulu ♀ in having tegulae, entirely, tubercles and a spot behind tubercles, ivory-white. Median lobe of clypeus armed apically with three equal teeth. Stigma larger. Marginal cell about twice as large as in the Honolulu species, the part beyond end of stigma somewhat less than twice as long as wide, instead of as long as wide."

*Astata immigrans* has a very short marginal and third submarginal cell, in this respect approaching the genus *Diploplectron* Fox.

On July 18, 1939, I observed some small wasps on a large spreading plant of *Portulaca oleracea* Linn. that was growing in the hot sunshine at Ewa Plantation Company, Oahu. Most of these wasps proved to be the active *Solierella rohweri* (Bridwell), but there was also a stouter-bodied species with a red abdomen that was new to

\* W. H. Patton (Can. Ent. 27 [1]:280, 1895) states: "*Astata montana*, Cress. [Syn. *Ast. elegans*, Cress., ♂ ♀; Syn. *Ast. bella*, Cress., ♂];—the three names belong to one variable species." Maidl and Klima (Hymenopterorum Catalogus, Pars 8, Sphecidae 1:22, 1939) accept Patton's synonymy. The present writer believes that more than one species is involved in this synonymy.



EXPLANATION OF PLATE XXXI

1. *Astata immigrans*, male. Length 5 mm.
2. *Astata immigrans*, male, head from in front.
3. *Astata immigrans*, female, head from in front.
4. *Astata immigrans*, male, portion of antenna, to show slight latero-ventral swellings basad on 7, 8 and 9.
5. *Astata immigrans*, female, pygidial outline.

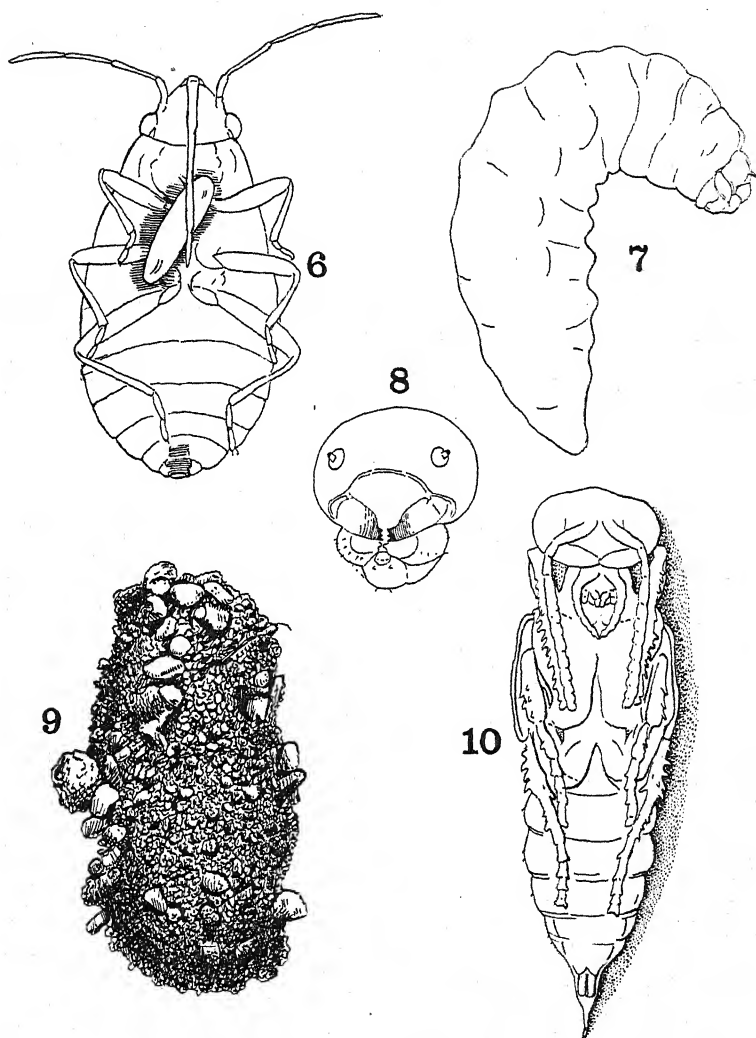
me. A half dozen of these, including both sexes in fresh condition were captured by means of wide-mouthed vials. They were determined as a species of *Astata*, and it was surprising, in my experience that insects of this genus, so wary elsewhere, could be so readily taken here.

No further attention was paid to *Astata immigrans* until June 19, 1942, when the wasps were found rather abundantly on *Portulaca* at the Experiment Station, H.S.P.A., Honolulu. The following year the first of these wasps was observed on May 22, at the same place; they continued numerous through June and July, becoming scarce by early August, although the last specimen, a male was taken on September 19. In 1944 it was first seen on June 10. On March 14, 1945 a female *Astata* was observed on *Portulaca* on the hot Waianae lowlands, and again specimens were seen on March 22, in Honolulu. The wasp is at least two-brooded here, becoming scarce or disappearing in the late fall and winter in the few acres at the Experiment Station, where their presence or absence may to some extent be regulated by the periodic destruction of *Portulaca* and other weeds there. I believe that in more favorable localities it may persist throughout the year, as does the little *Nysius* bug that constitutes its prey.

In sunny weather the male stations himself upon some stem or other convenient object from which he surveys his small world. The huge, chiefly lichen-green eyes and the shining wings make him conspicuous enough as he pivots about alertly or pursues some passing insect, to return to or near his station again. He appears to mate frequently and is often carried about by the female. The latter in her search for immature bugs creeps among the *Portulaca* stems or on the soil under the plants. Her eyes of the usual size are bluish, becoming black towards the mandibles.

It is very difficult to study the nesting activities of *Astata* in the field. She catches her relatively small prey, stings it to paralysis and is off in a flight too swift to follow. But I was rather successful in observing her activities in a large jar. In such a situation female wasps lived from 13 to 17 days.

On May 24, 1943, I placed several inches of sifted soil in two large jars, added some *Portulaca* plants, a quantity of immature *Nysius nigriscutellatus* Usinger (1942), a species of bug commonly found on this weed, and finally put in *Astata immigrans* wasps. Some days later the two wasps were observed each holding an immature bug to her breast. The nest holes were not located however, there being too much loose soil and debris about. Nevertheless, one of the two jars stocked with a single female wasp yielded a progeny of eight males and six females, between June 20 and 29. Thus the life-cycle—from egg to adult—occupied a minimum of about 26 days.



# EXPLANATION OF PLATE XXXII

6. Young *Nysius* bug with egg of *Astata immigrans* glued on its breast.
7. *Astata immigrans*, large larva.
8. *Astata immigrans*, larval head, last stage, slightly inclined forward from mouth.
9. *Astata immigrans*, cocoon. Length about 8 mm.
10. *Astata immigrans*, pupa. Length 6.5 mm.



Much better results were obtained commencing June 14, 1944, when a 9" x 15" jar was placed on its side so that a tongue of shallow, well-packed soil extended free from the mass of *Portulaca* plants towards the mouth of the jar. Young *Nysius* bugs were added from time to time and a single male and three female wasps introduced. On June 15, a fourth female was added. The jar was kept on the laboratory counter and away from direct sunlight. The soil was but slightly moistened. The wasps' activities were observed only at irregular intervals. The male wasp by his frequent matings appeared to interfere with nesting operations, carried on by the females.

Late in the morning of June 17 a single wasp was noted excavating her burrow on the tongue of soil. She would back out dragging a load of soil with her mandibles or throw it behind her with her fore feet, so that a low inconspicuous heap was formed before the short burrow. Presently she sallied forth among the *Portulaca* plants, to return at 11:25 A.M. with a *Nysius* nymph beneath her body which she thus carried into her burrow. Other bugs were brought in at 11:40, 11:49, 11:55 A.M., and at 12:00 M. Other *Astata* were observed nesting close by. They quarrelled to some extent.

The wasp likes to search the tips of the plant for her prey; she appears little excited when a suitable *Nysius* nymph is found, but grasps it and brings her abdomen beneath and forward to sting the bug to near immobility. One of these wasps observed malaxating her prey held it beneath her, venter up, by means of her first and second pairs of legs and applied her mouth parts to its throat and leg bases. When that is finished *Astata* grips the basal portion of the bug's antennae with her mandibles, releases the leg-hold and walks or hops off with her burden, by an often circuitous route, to the nest hole which she enters headfirst. The burrow except when completely stored appears to be always left open. It is a short affair of more than one cell, and each wasp undoubtedly excavates several burrows in her lifetime.

At least one individual was engaged in nesting activities as late as June 26. On the day following I carefully dug up the main burrow area. Small groups of bug nymphs were thus exposed in some cells, and in two cases there was an *Astata* egg glued obliquely on the bug's breast. The victims could do no more than twitch their toes. In other cells were larvae spinning their cocoons, and some prepupae and a pupa in their very flimsy envelopes. A few of these early stages were preserved.

The delicate, glassy white egg is about 1.05 mm. long (fig. 6). The larva (fig. 7), at least when well grown, shows no pilosity except sparsely about the mouth region of its globular head; the body is little modified, having no lateral thoracic papillae such as occur in the Larridae, and the lateral body ridges are not conspicuous.

The pupa (fig. 10) is at first creamy white with glassy appendages; the legs are short-spined while the abdomen bears dorso-lateral spine bands. It is an active wriggler. The cocoon (fig. 9) is a fragile affair of silk and grains of soil and unless carefully taken up in its entirety is likely to fall apart.

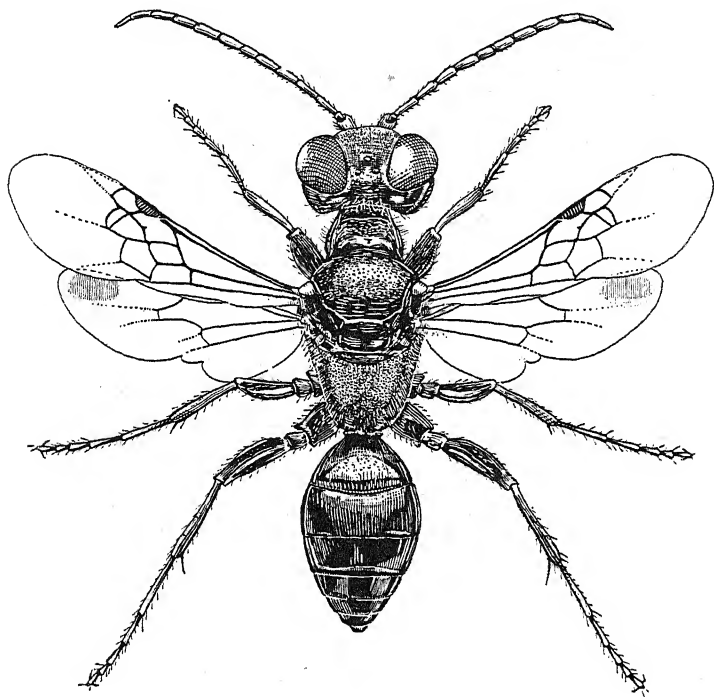


Figure 1.—*Diploplectron* sp., ♂. San Francisco, California.

In all, twenty-three individuals of *Astata* in various stages were secured from these cells. Six males and eleven females (two of which were in a crippled condition) were hatched, becoming fully developed from July 10-14.

Observations on the biology of other species of *Astata* have been made in several parts of the world by a number of entomologists. The species of Hemiptera which these wasps favor belong to the family Pentatomidae, but they also store bugs of the families Coreidae and Lygaeidae. In the San Francisco Bay region of California, I have found a species of *Astata* with a red abdomen preying upon adult *Nysius strigosus* Uhler and nymphs of what was probably *Lygaeus bicrucis* Say.

For literature on the genus *Astata* consult Hymenopterorum Catalogus, Pars 8: F. Maidl et A. Klima; Sphecidae I. (Astatinae—Nyssonidae), 1939.

The genus *Diploplectron* Fox (Trans. Amer. Ent. Soc. Phil., 20: 534, 1893) differs from *Astata* most obviously in the venation of the forewings, and in having the compound eyes of the male well separated at the vertex. The wasps average much smaller in size than *Astata*, and the genus has fewer species and a more limited distribution, occurring in the United States chiefly west of the Mississippi, and in South Africa. Further collecting will probably extend the distribution of these obscure little wasps. There may be considerable variation in wing venation among individuals of the same species of both *Astata* and *Diploplectron*, and our species need further study.

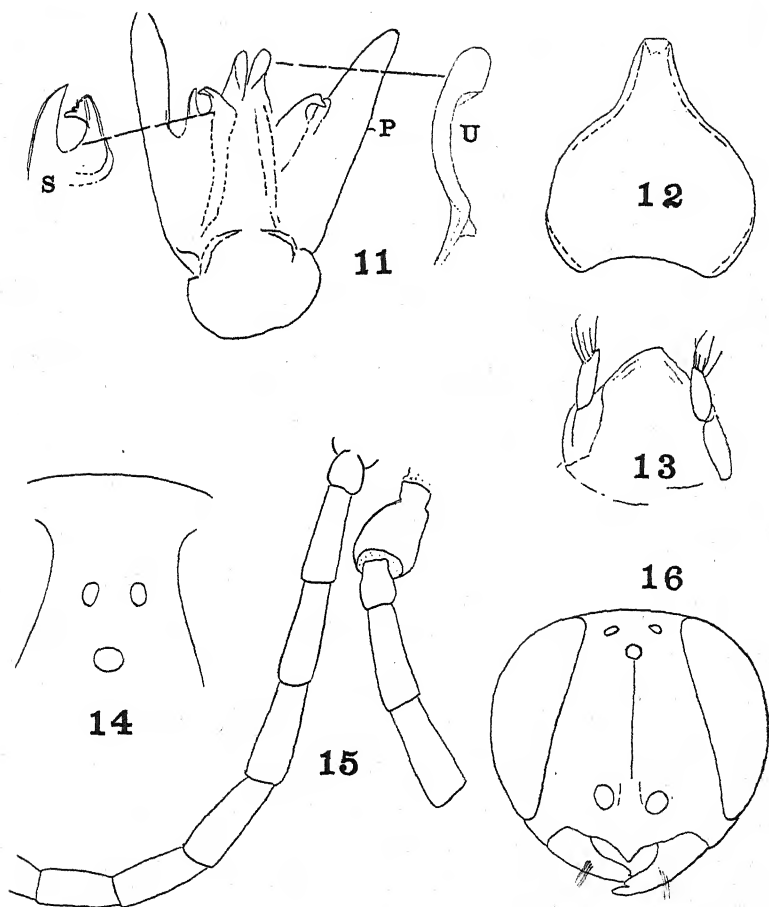
At least three species of *Diploplectron* are found in California. Two species occur in the region of San Francisco, while what may be a third species inhabits the Sierra Nevada Mountains. Southern California should yield one or more species. In San Francisco itself there is a *Diploplectron* (text figure 1) separable from a form that occurs nearby, at San Rafael, in Marin County and Menlo Park, San Mateo County, and no doubt elsewhere, chiefly in having longer antennal joints. These two insects, as far as known, inhabit different subfaunal areas.

The writer has made but scant observations on the biology of *Diploplectron*. In San Francisco, the wasp was noted chiefly during the summers of 1922 and 1930. The female *Diploplectron*, an active little polished black insect, keeps close to the ground, entering superficial holes and rummaging under debris in her search for the nymphs of *Sphragisticus nebulosus* (Fallen) (Lygaeidae), a small black bug that is found in such situations. The wasp stings her prey, grasps it by the antennae and bears it nestwards. She has the aggravating habit of hopping upgrade with her apparently heavy burden and then of disappearing in flight. The nest is dug in the sand, several bugs being stored in a cell. The egg is glued to the breast of one of these bugs. This wasp also preys upon bug nymphs of a paler color, species undetermined.

At Menlo Park, during the summer of 1937, another species of *Diploplectron* was taken preying upon an adult *Rhyparochromus californicus* Van Duzee and what appeared to be a nymph of *Emblethis vicarius* Horvath, both of the family Lygaeidae. The bug determinations were made by the late Mr. E. P. Van Duzee.

### ***Diploplectron reticulatus* n. sp. (plate XXXIII, figures 14-16)**

*Male*, type: Length 4.8 mm. Head and thorax subopaque, abdomen shining. Black; mandibles reddish with some yellow near base, antennae brownish, paler apically, first and second pairs of legs dark brown, tarsi paler, posterior femora, tibiae and tarsi orange-red, tegulae pale brown, postnotum and propo-



EXPLANATION OF PLATE XXXIII

11. *Astata immigrans*, male, terminalia; P, paramere; S, volsellar plate; U, lateral plate of aedeagus.
12. *Astata immigrans*, male, ninth sternite.
13. *Astata immigrans*, male, tenth abdominal segment.
14. *Diploplectron reticulatus*, male, type, ocelli.
15. *Diploplectron reticulatus*, male, type, portion of antenna.
16. *Diploplectron reticulatus*, male, type, head.

deum with faint indications of reddish, abdomen orange-red. Head very finely reticulate; clypeus drawn out mesad as a simple narrow lobe; antennal joints 3 and 4 subequal; interocular space at vertex slightly less than joints 2 + 3; ocelli in an acute triangle; line from anterior ocellus to near clypeus not strong. Thorax very finely reticulate, except scutellum which is largely glabrous; disc of propodeum finely reticulate in a transversely wavy effect, depressed mesad apically, only a trace of marginal curved groove; propodeal pleura finely reticulate and with short oblique carinulae, this sculpture more obscure on posterior face which has a triangular fovea above. First recurrent and first transverse-cubital veins interstitial, second recurrent received in middle of second submarginal cell, third submarginal cell of usual abbreviated form, about equal in length above and below; apex of posterior wing with an infumate spot. Last visible ventral segment with the apical portion narrowed, parallel-sided, rounded and subtruncate apically.

Tucson, Arizona, May 20, 1920 (F. X. Williams). One male in fair condition.

Evidently related to *D. vierecki* Pate (Ent. News, 52: 4-6, 1941) from El Paso County, Texas, but differs from that species in its simple, conically pointed clypeus and in its wholly reticulate mesonotum—without small, moderately close punctures.

Type to be deposited in the collection of the California Academy of Sciences.

The Occurrence of *Trypanosoma conorhini* Donovan in the  
Reduviid Bug, *Triatoma rubrofasciata* (Degeer)  
from Oahu, T. H.

By LT. SHERWIN F. WOOD H(S), USNR

(Presented at the meeting of August 13, 1945)

In 1942, C. E. Pemberton (Hawaiian Med. Jour., 2:192) reported a large number of specimens of *Triatoma rubrofasciata* (Degeer) collected in an old lumber pile in the Kaimuki district of Honolulu. Previous studies by Donovan (Trans. Bombay Med. Congr., 1909, Feb. 24: 159), Lafont (C. R. Soc. Biol., 1912: 380-382; Ann. Inst. Pasteur, 1912, 26: 893-922), Morishita (Japanese Jour. Zoöl., 6: 459-546) and Bonne (Geneeskundig Tijdschrift voor Nederlandisch-Indie, 1936, 76: 2483-2486) have pointed out the similarity of the parasites harbored by *T. rubrofasciata* to the causative agent of Chagas' disease, *Trypanosoma cruzi* Chagas.

After consultation with Honolulu entomologists, a search was made of some likely localities in the Kaimuki district May 26, 1944, by Dr. Walter Carter and the writer, but no *Triatoma* were found. Through the kindness of Dr. Carter, two male and two female *Triatoma rubrofasciata* collected by Mr. K. Ito under a chicken coop on March 27, 1945 were obtained. The insects were dead when dissected May 19, 1945 but one male and two females showed typical crithidial and trypanoform stages of *Trypanosoma conorhini* Donovan. One male collected May 24, 1945 from the davenport inside a neighbor's house was examined in Dr. Carter's laboratory on May 31, 1945 and revealed a heavy infection of the same parasite. Subsequently, Mr. K. Sakimura brought in nineteen nymphs, one male and one female from a house for cats in the Kaimuki district. All of these bugs were negative but another male and female collected by the writer with Mr. Ito in the same general area from under a chicken coop were heavily infected.

The structure of these parasites from stained smears and the characteristic motility of the trypanoform stages agree very closely with previous studies of the crithidial and metacyclic trypanosome forms of *Trypanosoma cruzi* harbored by *Triatoma protracta*, *T. protracta woodi*, *T. rubida*, *T. gerstaeckeri*, and *T. longipes*, in the United States.

The writer is indebted to Mr. Ed. Mau, in charge of the Plague Laboratory, for permitting use of laboratory facilities in maintaining the insect cultures.



## New *Usingerius* from the Philippines and Borneo (Coleoptera: Curculionidae)

By **ELWOOD C. ZIMMERMAN**

Bernice P. Bishop Museum, Honolulu

(Presented at the meeting of November 19, 1945)

The anthonomine genus *Usingerius* was described to receive its genotype, *U. maculatus* Zimmerman from the island of Guam (Bishop Museum Bull. 172:94, 1942). It is of considerable interest to be able now to record two new forms, one from the Philippines, the other from Borneo, thus removing another monotypic genus from the lists. Moreover, the new zoogeographical data are worthy of being added to the published record.

*Usingerius* has no tibial mucrones, the antennal funiculi are six-segmented, the tarsal claws are deeply cleft, the femora are toothed, the eyes are large, protuberant, close together above, and the vestiture of the dorsum of the body consists of prostrate squamules.

### *Usingerius rubens*, new species (fig. 1, *a*; fig. 2, *a*, *b*)

Female. Derm reddish brown, appendages paler reddish brown to brownish yellow; dorsal vestiture white everywhere except where there are some irregular and probably variable areas of dark, bronzy squamules; vestiture of appendages and under surfaces white.

*Head* with crown obviously depressed below level of eyes and slightly below interocular area, reticulate, minutely punctate, lanceolate squamules similar to those on pronotum, not concealing derm; interocular area about one third as broad as an eye as measured from above, derm concealed there by condensed squamules.

*Rostrum*, measured along its chord from dorsal apical margin to a point beneath anterior edge of an eye, as long as breadth of pronotum, evenly arcuate; with carina at middle, at dorsal margins of scrobes and one between these on sides distinct, the four grooves between these five carinae distinctly setose; antennae inserted at one fourth distance from middle to apex beyond middle; area beyond antennae shiny and minutely punctate.

*Antennae* with club of scape about as long as first antennal segment; first funicular segment as long as II plus III, segment II about as long as III plus IV, V and VI each slightly broader; club somewhat longer than preceding six funicular segments, joints between two basal segments deeply and distinctly marked.

*Prothorax* one fourth broader than median length to apex of prescutellar lobe, broadest at about middle; base shallowly concave on either side of prescutellar lobe; sides convex from base to beyond middle, thence concave to apex; subapical constriction continued across dorsum, the longitudinal outline of which is sinuous, basally convex, reaching its maximum height near middle and obviously discontinuous with longitudinal dorsal contour of elytra; densely, moderately coarsely punctate; squamules rather coarse, sublanceolate, decurved, mostly well separated, densest on prescutellar lobe and there concealing derm, also more condensed on sides in subapical constriction.

*Scutellum* convex, clothed with fine, appressed squamules.



*Elytra* about three fourths as broad as long, about three and one half times as long as side of prothorax (measured from side, prothorax from front to humerus, elytra from humerus to apex), nearly straight on sides from broadly rounded humeri to near middle, thence arcuate to apex; striae well defined; intervals broad, convex, minutely roughened and punctate; squamules similar to, but somewhat smaller and more appressed than those on pronotum, directed caudad and not echelon-like.

*Legs* rather loosely clothed with prostrate hairs; femora with teeth strongly developed throughout; fore femoral tooth almost forming an equilateral triangle, nearly as high as subapical breadth of a tibia; tibiae strongly sinuous on inner side, anterior pair almost twice as broad at about middle as sub-basally.

*Sternum* hirsute; prosternum with coxae so close together that vestiture of two coxae touches; metasternum with a median fovea behind, about as long at its narrowest point between mid and hind coxae as length of first ventrite behind a coxa; pleura squamulose.

*Abdomen* with ventrites finely punctate, hirsute, finely so on their disks, more coarsely laterad, the finer hair more slanting or suberect, the coarser hair or setae more prostrate; pygidium concealed.

Length (excluding head): 2.7 mm.; breadth: 1.4 mm.

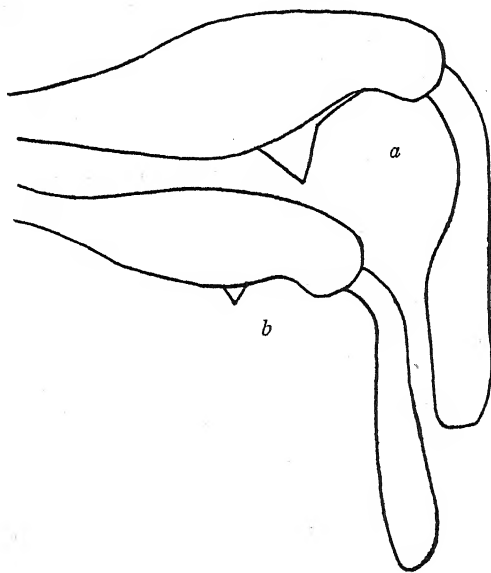


Figure 1.—Sketches of fore femur and tibia of *a*, *Usingerius rubens* Zimmerman, and *b*, *Usingerius rubens parvidens* Zimmerman.

Philippine Islands. Holotype female (United States National Museum, number 57243) collected by the late C. F. Baker at Dapitan, Mindanao (bearing the number 4477).

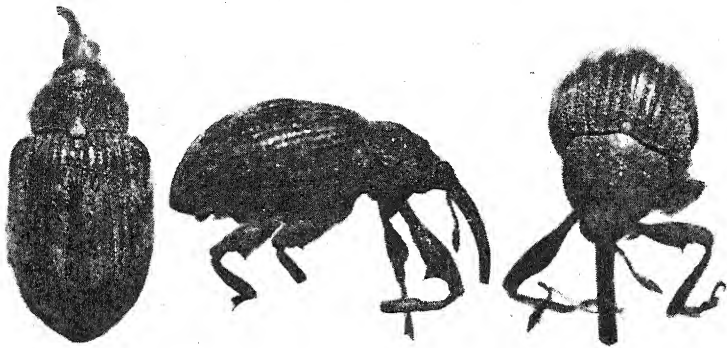


Figure 2.—New *Uisingerius*. *a*, dorsal, and *b*, lateral views of *Uisingerius rubens* Zimmerman. *c*, *Uisingerius rubens parvidens* Zimmerman. (Photographs prepared at the U. S. National Museum, and reproduced through the courtesy of L. L. Buchanan.)



This species differs specifically from *Usonianus maculatus* in a number of ways, some of the most salient of which are as follows: it is somewhat larger, proportionately broader, the vestiture is white instead of predominantly golden or yellowish, and the elytral squamules, in addition to being distinctly coarser, are all directed caudad instead of those along the middles of the intervals being directed caudad while those on either side are directed obliquely toward the median line as on *U. maculatus*.

***Usonianus rubens parvidens*, new subspecies (fig. 1, *b*; fig. 2, *c*)**

With the specimen described above, a single individual from Borneo also was sent to me for description. This second specimen is closely similar to typical *rubens*, but it cannot be assigned to that form because of certain distinctive features. A series of specimens might furnish additional information that will show that the forms are specifically distinct. However, with the inadequate material now at my disposal, I believe that it is best to consider this example as representing a geographical subspecies.

The description of *rubens* will apply almost in every way to this form excepting in the following particulars: The abdomen is typically feminine, with the pygidium concealed, and I believe the specimen is a female. However, the rostrum is more masculine, it is not as long as the breadth of the pronotum, the antennae are inserted at about the distal third, and the dorsal area beyond the insertion of the antennae is more coarsely punctured. The femora are not so heavy, and the teeth are obviously smaller. The tooth on the fore femora is only half as long as the breadth of a fore tibia. The fore tibiae are quite differently shaped, they are not nearly so sinuous along their inner edges, are not broadened submedianly as on *rubens*, and their submedian breadth is obviously less than twice as broad as the subbasal breadth. The differential characters of the legs can best be appreciated by examining the diagrams.

Length (excluding the head): 2.25 mm.; breadth: 1.25 mm.

Borneo. Holotype female (?) (United States National Museum, number 57244), collected by C. F. Baker at Sandakan, British North Borneo (bearing the number 15039).



Browne 1887, not Douglas 1888, the Author of *Orthezia insignis*  
(Homoptera: Coccoidea)

By ELWOOD C. ZIMMERMAN

Bernice P. Bishop Museum, Honolulu

(Presented at the meeting of November 19, 1945)

During a research trip to the mainland in 1940 while preparing manuscript for the forthcoming manual "Insects of Hawaii," I had an opportunity to check the original descriptions of various insects in journals not available at many institutions. This work in the nation's finest entomological libraries resulted in some rather unexpected results which will be published later, but it has been suggested that the case involving the common pest species, the greenhouse *Orthezia*, should be brought to light now. Hence, this note is presented here.

In August 1887, E. T. Browne read a paper to the Quekett Microscopical Club, and in series 2, vol. 3, pp. 169-172, plates 16-17, December, 1887 his paper was published in the society's "Journal" under the title "Notes on a Species of *Orthezia* found in Kew Gardens." In this paper he described and figured *Orthezia insignis*. This is the original description of the species, although I have never seen it credited to any author other than Douglas. The paper prepared by J. W. Douglas, however, "Note on Some British Coccidae," The Entomologist's Monthly Magazine, 24: 165-171 (the number for December, 1887) was not published until January 1888. Some authors have credited the species to Douglas and have cited the Journal of the Quekett Microscopical Society, 1887, as the reference, although that paper was written by Browne.

I have called this problem to the attention of Dr. Harold Morrison, who has also checked the matter carefully and has discussed it with Mr. C. F. W. Muesebeck. These workers agree with the conclusion that Browne is the author of the species. Dr. Morrison has kindly forwarded the following pertinent data:

Browne evidently studied his Kew Gardens discovery, going to the extent of looking up pertinent literature and comparing the insects with specimens in the British Museum. His paper contains a number of descriptive items, noted as characteristic of the genus *Orthezia*, but plainly based on his observation of this particular species. His comments on and figures of the adult male obviously are in error, almost certainly based on a *Pseudococcine* male. Browne quotes a communication from J. W. Douglas expressing his (Douglas') opinion that the insect is new. At no point in the text is the name *insignis* mentioned, nor are any claims made that the author (Browne) is attempting to describe a new species. However, in explanation for Plate XVI the following notation is made: "Fig 1. *Orthezia insignis*, male, x 30 diam." and this is followed immediately by "Fig. 2, *Orthezia insignis*, female, x 30

diam." . . . The error in attributing to *Orthezia* the male characterized by both Douglas and Browne was soon discovered and corrected in print by Mr. E. E. Green.

What has happened, it appears, is that Browne "scooped" Douglas in describing the species, although he did not do so intentionally. Browne was apparently more intent upon describing the habits of the species than naming it as a new insect, as indicated in the following statement by Douglas (1888, p. 171): "In August Mr. Edward T. Browne, Unbridge Lodge, Shepherd's Bush, sent me several examples of this species, which he had obtained in the Royal Gardens at Kew, requesting that I would describe it if new, . . ." However, it is essential to have certain basic technicalities to make for stability in nomenclature, and according to the rules of zoological nomenclature Browne first described, figured and gave a name to the species. The credit belongs to him, and the species should be known as *Orthezia insignis* Browne.

## A Remarkable New Pseudopsectra from Maui (Neuroptera: Hermerobiidae)

By ELWOOD C. ZIMMERMAN

Bernice P. Bishop Museum, Honolulu

(Presented at the meeting of December 10, 1945)

Flightless derivatives of volant native insects are always fascinating objects of study. Herein is presented the description of *Pseudopsectra cookeorum*, one of the finest and most spectacular of all of the known Hawaiian Neuroptera. Its discovery gives further weight to the opinion that a whole series of such local, aberrant offshoots of the large Hawaiian genus *Nesomicromus* remain to be discovered by diligent collecting. The evolutionary processes which are responsible for the origin of this unusual creature have created a flightless, spinose "monster" whose salient characters are unique among its known allies.

### *Pseudopsectra cookeorum*, new species (fig. 1)

Derm mostly glistening, appearing as if wet, basically brownish yellow marked with fuscous and piceous; head and antennae nearly concolorous, spines on crown darker; thoracic nota similarly colored, but pronotum tending to be darker on side margins; legs with femora somewhat clouded, fore and mid tibiae rather obscurely darkly biannulate; venter of abdomen yellowish apically but becoming darker basad; fore wings with entire margin with subequally spaced dark marks which make an alternating dark and pale marginal pattern, main veins with variable and irregular dark maculae.

*Head* with face shiny, but derm shallowly punctate, minutely alutaceous, finely hirsute; crown irregularly protuberant, asperate, setose, conspicuously spinose, the spines bipartite, each consisting of an elongate, heavy, rod-like base from the apex of which arises a strong, acuminate seta; antennae about as long as greatest chord of a fore wing; terminal segment of maxillary palpus about twice a long as penultimate, flattened, lanceolate-acuminate; distance across eyes, as seen from front, equal to length of pronotum plus about one half of crown.

*Thorax* with pronotum about one sixth broader than long, surface roughened by small tubercle-like bases of numerous, bipartite, short spines, and dorsum bristling with conspicuous, large, bipartite spines similar to but larger than those on crown, the larger of these fully as long as diameter of an eye (about 0.25 mm.), these large spines confined to the three transverse, lobe-like zones on dorsum, posterior zone with one spine on either side of median line, median zone with five to seven large spines on either side, anterior zone with about nine to twelve spines; median line of disk well defined anterior to basal zone, free from large spines and separating the median and anterior zones into halves; mesonotum with similar small and large spines, and with about four or five large spines on either side, metanotum with only a single pair.

*Wings* with fore pair shaped as illustrated, venation as illustrated, about twice as long as broad, hind (dorsal) margin continuously arcuate, thick,



entirely coarsely reticulated by a network of multitudinous, coarse, cross-veins all armed with small, bipartite spines, and marginal veins, main veins and their principal branches armed in addition with large, very conspicuous bipartite spines as on head and thorax, but some of them larger (some 0.4 mm. long); hind wings minute, easily overlooked fleshy flaps about 0.1 mm. long, evidently veinless.

*Legs* with fore and mid femora and tibiae bristling with spines and setae, hind pair setose but with fewer spines.

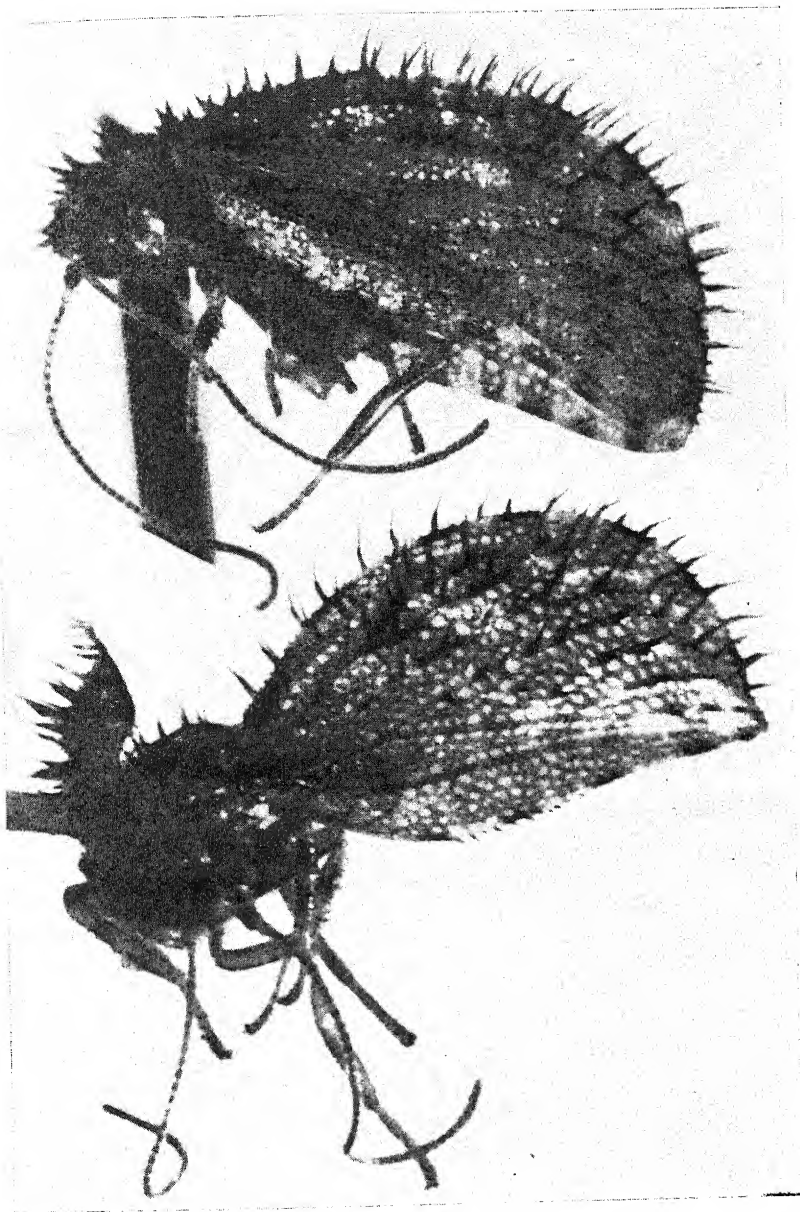
*Abdomen* moderately shiny; conspicuously setose, the setae arising from distinct basal granules.

Length (wings closed against body, measured from front of head to apex of wing): about 4 mm.; expanse: about 7.5 mm.

Island of Maui, Territory of Hawaii. Holotype male and allotype female beaten by me from *Dubautia* growing on the steep slope just inside the rim below the summit of Haleakala Crater at about 9700 feet elevation on April 25, 1945.

It is with much pleasure that I dedicate this remarkable indigene to my close friends, Dr. and Mrs. C. Montague Cooke, Jr., whose kindness and interest in my work made possible my 1945 collecting trip to Maui.

In my "Studies of Hawaiian Neuroptera" (Proc. Hawaiian Ent. Soc. 10 [3]: 487-510, 1940), two species were added to the then monotypic *Pseudopsectra*, and it was pointed out that with the discovery of the new species the gap between *Pseudopsectra* and *Nesothauma* had been reduced. This new species further reduces that gap. The prominent spines on the fore wings, thorax and head are distinctive, but these, remarkable as they are, are only relatively spectacular developments of the fine hairs or setae of our other hemerobiids. The pronounced reticulate pattern formed by the veins and cross-veins in the fore wings is shared by other species, especially by *P. sweseyi*.



Zimmerman *Pseudopsectra*, Proceedings, 1945 (1946)

Figure 1.—*Pseudopsectra cookeorum* Zimmerman, new species. Male holotype (upper figure) and female allotype. (Photographs by J. T. Yamamoto, courtesy of the Hawaiian Sugar Planters' Experiment Station.)



## NEW INSECT RECORDS FOR THE YEAR 1945

Species marked with an asterisk were reported in the Hawaiian Islands for the first time in 1945, on the dates recorded in the text. Those not so marked were observed here prior to that year, but have only now been identified. For particulars refer to the pages indicated.

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